Saskatchewan
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Chemical Use and Distribution in the Regina Aquifer Region

Volume I

December, 1989

CHEMICAL USE AND DISTRIBUTION IN

THE REGINA AQUIFER REGION

VOLUME I

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ACKNOWLEDGEMENTS

This report has been prepared by Saskatchewan Environment and Public Safety in association with Saskmont Engineering Limited.

The authors would like to acknowledge the time and effort expended by the businesses and institutions who participated in the survey.

The constructive criticisms by the various groups within Saskatchewan Environment and Public Safety were also appreciated.

EXECUTIVE SUMMARY

Introduction

The primary purpose of this report was to evaluate the management and distribution of hazardous chemicals in the Regina aquifer region. This study is part of an ongoing program to develop a protection plan for the Regina aquifer system. A proactive aquifer plan requires knowledge of the materials being utilized, stored and how they are being handled in government, manufacturing and business in the Regina region.

The objectives of the study involved:

- classifying and estimating the total volume of hazardous chemicals in storage and use;
- estimating the volume of hazardous chemicals being produced as waste from business and industry; and
- documenting disposal methods;

Summary of Investigation

The operations to be surveyed were initially contacted by letter, and ultimately through an on-site visit in which the operator responded to a questionnaire and provided a tour of the facilities. A total of 169 businesses and institutions participated in the survey. The survey area included the Rural Municipalities of Lumsden, Edenwold, Pense, Sherwood and the City of Regina.

Estimates of volumes of hazardous chemicals used on-site were provided by the owner or operator representative. The survey was conducted on a face to face basis with follow up where information, particularly on volumes of chemicals, was not readily available.

The survey results were compiled manually and information was then summarized utilizing the Transportation of Dangerous Goods classification systems.

Collected data was then broken into its appropriate industry section and compiled into totals for each section. Other data was broken into geographical regions and classes to show the distribution of chemicals and chemical spills in Regina and the surrounding area.

Results

The bulk of the chemicals in the Regina Aquifer region are in storage and use within Regina. The largest percentage (97.8%) are located in the northeast quadrant of Regina, an area bounded by Albert Street to the west and Victoria Avenue to the south. This is also the area with the greatest industrial activity.

The northeast quadrant is part of the aquifer recharge area, which could allow ready contamination from spilled or discarded hazardous chemicals.

There are many factors associated with hazardous chemical use which cause the materials to be of concern with respect to the ground water resource. The primary factors include the type of chemical, the volume and the storage method.

The review of these factors indicated that the Petrochemical Industry poses the greatest risk to the Regina Aquifer system.

The potential risk is due to the large volumes of class 3 (petrochemicals) materials stored and utilized on an annual basis. Leakages from tanks or pipelines could result in several million litres of product escaping.

The agricultural chemical distributors and certain commercial chemical suppliers ranked second in terms of risk. They maintain large volumes of chemicals in concentrated form. They are less susceptible to a major spill as the majority of their chemicals are stored above ground in small volume packages. Therefore a major spill would likely require some associated catastrophe such as a warehouse fire or explosion. There is risk of contamination from leakage from bulk tank storage facilities although volumes are less than those associated with the petroleum industry.

The other eleven groups tend to utilize small volumes of chemicals and thus do not represent as large a risk.

All of the groups are a concern because handling procedures particularly with respect to hazardous wastes are creating risk for the region's groundwater resource. Often wastes are disposed of by pouring them on the ground or are picked up by disposal companies who are unaware of the type of material and/or appropriate methods of disposal.

Northeast Regina is the area most at risk from spills. The spills in this area have historically been large petrochemical spills and remediation work has been minimal, consisting only of recovery of free product. The other large volume spills in the study area have been sewage releases. These spills pose a minor risk to the ground water system, as clean up of spills of this type are initiated immediately.

Landfills and lagoons if properly sited and operated pose little threat to the aquifer system. However, field investigation showed that most landfills are loosely supervised. As a result, hazardous materials are being deposited in landfill areas. Hazardous materials are being disposed of in landfill sites because of a lack of understanding of the implications, a lack of

disposal methods and because of a lack of enforcement. To minimize hazardous waste materials deposition in landfills, careful scrutinizing of material being trucked in and more stringent enforcement of present regulations is necessary by the landfill operators and regulatory agencies.

Recyclers in general present a minor risk to the aquifer. The only relatively large stream of waste which may have some impact on the aquifer system is used oil. One operator north of Regina is spreading approximately 100,000 litre/year as a dust suppressant.

In order to protect the Regina aquifer system and minimize the risk of contamination of this resource the following recommendations are being made:

- regulations for industrial expansion as relating to the protection of the groundwater resource should be reviewed.
- building and safety regulations should incorporate measures to protect the aquifer in areas which are susceptible to contamination (i.e. impervious pads for above ground storage, spill detection for underground storage).
- the use of underground chemical tank storage should be discontinued in high risk areas or require appropriate monitoring equipment.

- industrial zoning should incorporate protection of the groundwater resource.
- building design criteria should be established for the warehousing of large volumes of hazardous chemicals.
- general eduction programs should be developed to demonstrate the environmental risk of improper hazardous waste disposal.
- a recycling or "bulking" program should be established to help small volume generators of recyclable hazardous waste.
- hazardous waste regulations need to be developed to ensure proper waste disposal and management, and also to ensure protection of the environment - Regina Aquifer.
- existing regulations need to be enforced at landfill sites.

Volume

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Saskatchewan
Environment and
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Chemical Use and Distribution in the Regina Aquifer Region

Volume II

December, 1989

CHEMICAL USE AND DISTRIBUTION IN THE REGINA AQUIFER REGION

VOLUME II

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1.0 INTRODUCTION

1.1 Report Objectives

This report was commissioned by Saskatchewan Environment and Public Safety. The primary purpose of this report was to provide information on the volume distribution and use of hazardous materials in the Regina aquifer region. It is an essential component of a series of studies required to develop a management plan to ensure protection of the ground water resources in the Regina Aquifer Region.

The specific objectives of the study involved:

- Contacting and surveying chemical manufacturers and users in the Regina region.
- Classifying and estimating the total volume of hazardous chemicals in storage and use.
- Estimating the volume of hazardous chemicals produced as waste from business and industry and documenting disposal methods.
- Identifying the volume of chemicals and user or manufacture groups which could be using more appropriate disposal methods.
- Assessing the risk of interaction of hazardous materials and the Regina Aquifer.
- Identifying opportunities to increase recycling.

1.2 Report Organization

The report is comprised of two volumes. Volume 1 is an executive summary which provides an overview of the situation in Regina with regards to the use and management of hazardous chemicals. Volume 2 is the detailed report which presents the data by business sector and region. Cumulative statistics are presented in the appendices of Volume 2.

2.0 METHODS

2.1 Sample Survey

In order to obtain the information rapidly and with a consistent level of quality an approach was made to each business to be surveyed first through letter, then phone contact and ultimately through an on-site visit in which the operator responded to a questionnaire and provided a tour of the facilities. A sample of the initial contact letter and the questionnaire appear in Appendix A.

Estimates of volumes of hazardous chemicals used on-site were compiled from information provided by the owner/operator's representative. An effort was made to ensure the representative providing information was familiar with the operation and could provide quality data.

The survey was conducted on a face to face basis with follow up where information, particularly on volumes of chemicals in-use and wastes, was not readily available. In total there were 169 individual sites surveyed.

2.2 Materials Classification

The survey results were compiled manually with details of chemical composition and Materials Safety Data Sheets where possible. This information was then summarized utilizing the Transportation of Dangerous Goods classification system. This system uses 9 classes of material with a variety of divisions under each class. The classes include:

- **CLASS 1 EXPLOSIVES**
- **CLASS 2 COMPRESSED GASES**
- **CLASS 3 FLAMMABLE LIQUIDS**
- **CLASS 4 FLAMMABLE SOLIDS, SPONTANEOUSLY COMBUSTIBLE, DANGEROUS WHEN WET**
- **CLASS 5 OXIDIZING SUBSTANCES AND ORGANIC PEROXIDES**
- **CLASS 6 POISONOUS AND INFECTIOUS SUBSTANCES**
- **CLASS 7 RADIOACTIVE MATERIALS**
- **CLASS 8 CORROSIVES**
- **CLASS 9 MISCELLANEOUS PRODUCTS OR SUBSTANCES, DANGEROUS GOODS, HAZARDOUS TO THE ENVIRONMENT, DANGEROUS WASTES**

2.3 Study Area

The study area included the City of Regina and the Rural Municipalities of Sherwood, Edenwold, Pense and Lumsden. The City of Regina was divided into quadrants utilizing Victoria Avenue as the north-south division and Albert Street as the east-west divider (Appendix A - Figure A-3).

The boundaries of the four rural municipalities were utilized (Appendix A - Figure A-4) for division of the rural sample area. This allowed coverage of the area above and surrounding the Regina aquifer and provided a base to organize and present the data.

3.0 RESULTS AND DISCUSSION

3.1 Introduction

The organizations surveyed were grouped by general areas of activity. The groupings are arbitrary but facilitated the organization of the data. The chemical totals have been presented for each grouping based upon the average amount maintained in stock, and the total annual amount which may be the amount consumed in a process or the annual throughput of a warehouse. Where applicable the total material which is discharged as waste on an annual basis along with an estimate of the annual amount which is recycled is also presented.

We attempted to contact all the operations which were known to utilize a significant volume of chemicals. Time constraints precluded the gathering of all relevant information, thus the volumes provided tend to underestimate the actual volumes of chemicals in storage and use in Regina.

The report is considered a starting point providing an overview of the types of chemicals, the volumes and the handling and disposal practices. In many cases follow up is required to determine the end point for the waste generated. Further work is required to improve the waste handling procedures and increase the recycling of produced wastes.

It became obvious during the course of the surveys that many of the small businesses need assistance in co-ordinating the pooling of their recyclable wastes to ensure the volumes are large enough to be of interest to commercial recyclers. For example waste solvents are often being disposed of in the landfill or accumulating in steel drums in storage areas.

These types of problems need to be addressed in order to lower the risk to the Regina aquifer.

3.2 Industry Classification

The operations included in this report were grouped under 13 different headings. Two criteria were used to segregate the

operations into groups; the chemicals consumed and the general activity of the business. Therefore businesses with similar chemical use and operations were grouped together.

3.2.1 Commercial Chemical Manufacturers

.1 Introduction

This designation includes a variety of chemical manufacturers and distributors who formulate and distribute, or warehouse and distribute chemicals. The 13 companies surveyed within this group can be broadly grouped into manufacturers and distributors of household and institutional cleaning products, formulators of paints and pressurized gases, manufacturers and distributors of water treatment chemicals and warehouse and distribution of industrial process chemicals. These operations tend to employ as few as 2-3 employees in the warehouse and distribution operations to as many as 25 employees in the production and distribution operations. Agricultural chemicals are not included within this group.

.2 Process

The manufacturers and distributors all tend to manufacture chemicals under their own name brands. The amount of blending and packaging varies with the particular operator. Most also repackage bulk chemicals purchased from outside agencies. Their processes generally consist of mixing several chemicals with a carrier such as a solvent or water and repackaging and labelling

containers. Containers were usually plastic bottles of 1 or 4 litres and 20 litre plastic pails.

The businesses supplying chemicals to industry tend generally to operate as a sales, warehouse, and distribution centre rather than a manufacturer or processor. Chemicals tend to be received in bulk or in larger containers (20 l, 205 l, etc). The chemicals are stored in warehouse conditions on concrete floors.

The water treatment chemical suppliers tend to blend and or repackage chemicals in small batches to suit customer needs as well as functioning as sales and warehousing operations.

The volume of chemicals in storage does not appear to fluctuate widely on a seasonal basis. The class and volume of chemical in storage are presented in Table 3-1. Although waste levels were identified the waste could not be accurately classified at the time of the survey.

The paint manufacturing process involves blending several materials (pigments, hardners, solvents) into a formulated product.

Operations at pressurized gas manufacturing plants consist of separating atmospheric gases and then pressurizing them into cylinders or combining water with solid reagents to produce the desired gases which are collected, pressurized and stored in steel cylinders.

TABLE 3-1

COMMERCIAL CHEMICAL MANUFACTURES CHEMICAL INVENTORY,
REGINA AQUIFER REGION, 1989

CLASS	STOCK	ANNUAL	WASTE	RECYCLED
2	1320 m^3	54540 m^3		
2	226500 kg	145250000 kg		
3	281150 L	5538250 L	33750 L	
4	13636 kg	16363 kg		
4	25 kg	250 kg		
5	5500 L	50000 L		
6	150 kg	150 kg		
8	396831 L	768000 L		
8	36500 kg	155000 kg	318000 kg	
9	3000 L	13000 L	400 L	
9	48000 kg	830000 kg		

.3 Waste Handling

The volume of chemical wastes produced by this group tends to vary with the type of operation. In general these businesses indicated they produced no chemical waste, although most admitted some material was discharged to drains during the clean up between products. Two of the operators both of which formulate or package all of their own chemicals, did have large waste tanks which received wastes from general clean up and process spills. These underground storage tanks where emptied by sanitation companies but neither operator could provide information on the volume of waste generated or the final destination of the wastes handled by the waste haulers. In both cases the underground storage tanks lacked a monitoring system. Timing of discharge was based upon a visual inspection of the tanks.

Paint manufacturing generates a substantial liquid waste stream. The washing and cleaning of mixing tanks between different products results in an organic solvent waste stream. The industry also generates a solid waste stream which is essentially dried paints.

Waste solvents are packaged in drums and shipped to a solvent recycler for recovery.

The pressurized gas industry produces a slurry waste of sodium hydroxide and calcium hydroxide. The sodium hydroxide is a

relatively small stream. This material is hauled by vacuum trucks to the Regina landfill. Calcium hydroxide slurry which is the major source of waste is transferred to a lagoon where the material is dewatered through evaporation. The residual is recovered and transferred to the Regina landfill.

.4 Potential Environmental Risk

This industry group generally appears to handle and store chemicals in a responsible manner. There was a good general level of knowledge of the WHMIS Program and all of those surveyed had addressed the MSDS requirements of WHMIS.

Follow up is required with several of the chemical formulators to determine the volume of wastes produced, handling of the waste and disposal methods. These wastes present a potential problem for the Regina aquifer if they are being hauled and disposed of in an improper manner.

The companies in this group carry large chemical inventories. Generally however the chemicals are warehoused in small volume containers (20 l or 40 kg and less) thus significantly reducing the threat of a large volume spill interacting with the Regina aquifer. This industry does tend to maintain several different classes of chemicals in close proximity and therefore fire would be the most likely scenario under which large release of materials might occur.

The paint industry poses a greater threat to the Regina aquifer because large volumes of solvent are stored in underground tanks. A leak from these tanks could directly contaminate the Regina aquifer. A fire or explosion would also result in the release of chemicals from the small volume containers.

The pressurized gas industry poses little risk to the environment from product release. Effects are likely to be temporary and limited in area, except in the event of a fire, where an explosion could cause significant damage to the production facility.

The waste product which is a caustic slurry poses a long term potential risk to the Regina aquifer. Loss through leaching at the settling lagoons or the disposal site could introduce contaminants which could impact ground water quality. The waste handling procedures require review to ensure the risk to the ground water source is minimized.

3.2.2 Agricultural Chemical Suppliers

.1 Introduction

This grouping includes a broad range of activities. Each of the businesses supplies herbicides and/or pesticides to the farm community for pest control. Some formulation is carried out locally but generally the material is manufactured and packaged outside of Saskatchewan, and warehoused in Regina. The volume of

material in storage is seasonally dependant, tending to be greatest in late winter and early spring and dissipating during the course of the planting and growing season.

Small quantities of unregistered chemicals are also maintained for research and development purposes. These chemicals appear to be handled carefully for both safety and priority reasons. Residuals from these materials are shipped back to the original production facility.

In addition to the agricultural chemical suppliers we have included several of the pest control companies and a fertilizer producer in this group for organizational purposes.

The survey group included 17 different businesses.

.2 Process

The process is variable for this grouping. The finished product arrives by rail carrier or truck, the material is then warehoused and redistributed by truck on an as required basis. Alternately the active ingredient may be received in bulk, usually shipped in rail tank cars, it is then stored in above ground or underground tanks, blended and packaged for distribution. The bulk of the materials tend to be stored in small packages 4 and 20 litre pails or 40 kg dry packaging.

Table 3-2 shows the volumes and classes of material used by this group of business.

.3 Waste Handling

There is little waste produced by this particular group. The material is usually stored in a warehouse environment in small volume plastic, metal or paper containers. Spills or leaks are easily detected and cleaned up. Dry material is repackaged, while liquids are picked up with absorbent material which is landfilled, or shipped back to the original supplier.

The pest control companies generate little chemical waste. The products they use are mixed with a carrier and placed in the environment as bait or spray. Historically, some chemicals have been banned from further use and the remaining stock becomes waste. This material has been returned to the manufacturer or shipped to the city of Regina landfill.

The fertilizer manufacturing facility accumulates their waste products in specially designed lagoons and stockpiles which act as long term storage facilities. Spilled product can usually be recovered.

.4 Potential Environmental Risk

The chemicals handled by this industry eventually become widely

TABLE 3-2

AGRICULTURAL CHEMICAL SUPPLIERS CHEMICAL INVENTORY
REGINA AQUIFER REGION, 1989

CLASS	STOCK	ANNUAL	WASTE	RECYCLED
2	4080 kg	4080 kg		
2	280 L	280 L		
3	1400 kg	1400 kg		
3	3000000 L	4800000 L		
4	133558 kg	133558 kg		
5	9000 L	9000 L		
6	10028000 kg	30186000 kg		
6	500 L	10000 L		
8	5025000 kg	15000000 kg		
9	52000 kg	128000 kg		
9	4000 L	58000 L		

Totals based on 17 chemical suppliers

dispersed in the environment. Large quantities are maintained, in inventory but the risk to the environment occurs during the transfer process between storage facility and secondary warehousing. The greatest threat to the ground water resource occurs when liquids are transported in bulk by either tank cars or trucks. If a leak or spill occurred material could find its way into the aquifer system.

Storage of solvents in underground tanks also poses a risk to the aquifer. Leakages could directly contaminate the aquifer.

The packaged product poses less threat during storage because the small volume of the containers significantly reduces the risk of a major spill. This threat however would be increased substantially in the event of a catastrophe such as an explosion or fire in the warehousing areas.

3.2.3 Petrochemical Industry

.1 Introduction

This includes businesses directly involved with the manufacture, storage and transportation of petroleum products. Due to the timing of this study and the implementation of the Hazardous Substance Regulations, data on the service station industry is not included in the summary tables. This data will be presented in a separate report.

There were a total of seven companies surveyed in this grouping.

.2 Process

The manufacturing of petroleum products consists of processing crude oils into marketable refined products. The process includes crude and vacuum fractionation, conversion of the fractions via fluid catalytic cracking and delayed coking units. Finishing of the crude fractions is carried out through various procedures. The complexity of the process creates a variety of waste product streams. These streams primarily include wastewater, spent catalyst, spent lime, tank sludges, coke and sulphur.

The storage and transportation sectors of the petroleum industry include tank farms for storage and underground pipelines and tank trucks for transportation.

Table 3-3 provides inventory levels and identifies the variety of classes of materials used in the petrochemical industry.

.3 Waste Handling

Wastes are primarily associated with the production end of this industry. Small volumes of waste lubricants tend to be produced by transportation activities. Waste petroleum products are generally recycled. Production wastes which include spent caustic

TABLE 3-3
PETROCHEMICAL INDUSTRY, CHEMICAL INVENTORY
REGINA AQUIFER REGION, 1989

CLASS	STOCK	ANNUAL	WASTE	RECYCLED
2	1000000 L	140000000 L		
3	201405000 L	2946000000 L		
8	70000 kg	700000 kg	700000 kg	700000 kg
9	180000 L	3100000 L	3100000 L	
9	1000000 kg	65000000 kg	65000000 kg	62000000kg*

Totals based on 7 Petrochemical Industry Operations

*By-Products which are sold to other industries as raw materials

solution, catalyst and tank sludges are disposed of through deep well injection or land farmed in the area north of Regina. Process water is discharged to sanitary sewers after treatment to remove oil. Process produced materials such as sulfur or coke which were once considered waste are now sold as by-products or used in the process.

.4 Potential Environmental Risk

This particular industry group presents the largest risk to the Regina aquifer. The risk classification is caused by the large volume of chemical, primarily class 3 in storage and transport. The daily large volume requirements are caused by commercial and domestic transportation demands. Associated spills are greater than for other industries and remediation work tends to be difficult.

3.2.4 Livestock Operations

.1 Introduction

This grouping involves commercial livestock operations within the rural municipalities surrounding Regina. The Regina aquifer extends into these municipalities and could therefore be impacted by wastes produced by these operations.

.2 Process

The types of operations in the survey included feedlots, egg and poultry producers, hog producers, sheep producers and horse

breeding and stable operators. The process involves the feeding and raising of livestock which produces animal mass and animal waste. It is estimated that there are in excess of 17,000 animal units (Table 3-4) maintained in the four rural municipalities of concern. Where 1 cow plus a 400 lb. calf equal 1 animal unit, or 100 chickens equal one animal unit.

.3 Waste Handling

The volume of waste produced is estimated based on the animal unit system. The wastes are handled in various ways. On open pasture land with free ranging animals the waste decomposes where it is deposited. The movements of the animals serve to disperse the waste such that little impact on the ground water resource is expected. In situations where the animals are concentrated, such as a feedlot, or housed in a barn the waste material is usually collected, and stored in piles or spread mechanically on agricultural lands.

.4 Potential Environmental Risks

When animal wastes are widely dispersed on agricultural lands the material is generally considered to pose little threat to ground water resources. Where manure is concentrated, runoff and leaching could carry nutrients and bacteria into surface water and ground water. This could degrade water quality to an extent as to make it unusable for domestic consumption.

TABLE 3-4

ANIMAL UNITS AND ANIMAL HEAD PER R.M. INVENTORY
REGINA AQUIFER REGION, 1989

R.M.	CATTLE/ CALF	TOTAL PIGS	TOTAL SHEEP	HORSES	HENS/ CHICKENS	TURKEY	TOTALS
158	6271	1269	319	586	30804	318	39567(head)
	4317	253	45	732	308	3	5660(units)
159	1042	578	-	217	12199	123	14159(head)
	717	115	-	271	121	1	1227(units)
160	2890	2084	57	124	8486	100	13741(head)
	1989	416	8	155	84	1	2655(units)
189	6182	-	321	412	283121	283	290319(head)
	4256	-	45	515	2831	2	7651(units)
TOTALS	16385	3931	697	1339	334610	824	357786(head)
	11280	786	99	1673	3346	8	17194(units)

R.M. 158: Edenwold
R.M. 159: Sherwood
R.M. 160: Pense
R.M. 189: Lumsden

Cattle/Calfs - include beef cows, bulls feeder cattle, dairy cows, yearlings and replacement heifers

Total Pigs - include boars, sows, gilts, feeder pigs, weanling pig, suckling pigs

3.2.5 Commercial Cleaners

.1 Introduction

This portion of the report is based upon 6 interviews with dry cleaners and industrial laundry services.

.2 Process

These businesses tend to have remote locations which are dispersed throughout the City. These facilities are collection points for the garments and other materials which are gathered and transported to a central processing facility.

The dry cleaners utilize an estimated 187,000 l of perchloroethylene annually. Most of the perchloroethylene is lost to the environment on the cleaned fabrics and through direct evaporation. About 45 l of liquid waste is produced per year.

The laundry operations utilize detergents and bleaches to clean articles. The wash water is discharged to the city sewer system.

The chemical inventories for this group is presented in Table 3-5.

.3 Waste Handling

All of the chemicals used in this industry are discharged to the environment as waste. Most of the materials are diluted with water or oil. The bleaches and detergents are treated at the sewage treatment plant. The majority of the perchloroethylene is

dispersed in the atmosphere. The waste liquid perchloroethylene is hauled to the Regina landfill.

During the cleaning process, oil is removed from garments. The oil is distilled from the cleaning fluids, collected and recycled. About 3600 l of oil is recovered and recycled by this process annually. Unidentified solid wastes are collected and transported to the landfill.

.4 Potential Environmental Risk

The wastewaters are treated as domestic wastewater and therefore pose no extraordinary threat to the environment. Care should be taken to minimize water consumption as much as practical as this resource is in limited supply.

The handling of perchloroethylene is a concern as 180,000 L are dispersed to the environment in Regina each year. Most of it is dispersed to the atmosphere and therefore poses little direct impact on the Regina aquifer.

3.2.6 Commercial Printers and Photo Developers

.1 Introduction

This particular designation is comprised of two groups. The first being the commercial printers who produce everything from business cards and letterhead to newspapers. The industry includes operations which vary in size from a few employees to several

TABLE 3-5

DRY CLEANERS CHEMICAL INVENTORY
REGINA AQUIFER REGION, 1989

CLASS	STOCK	ANNUAL	WASTE	RECYCLED
3*			3600 L	3600 L
4	18450 L	49500 L		
8	50900 L	130000 L	130000 L	
9	40970 L	187000 L	187000 L	

*Class 3 waste originates from the clothes and leaves as waste

Totals based on 6 dry cleaners

hundred. Use and consumption of hazardous goods is generally relevant to the size of the operation. Six printers were interviewed for the survey.

The second part of this group is the photographic developers. This consists of the one-hour retail developers and the large volume custom printers who carry out processing directly for customers, both amateur and professional and for other large film retailers such as pharmacies or major retail chains. A few of the commercial printers also have inhouse photo development. Three photographic developers were included in the survey group.

.2 Process

The process used by commercial printers generally consists of applying ink to paper of various grades or using photographic processes to develop an image on paper. The operators utilizing the ink printing process tend to utilize inks and hydrocarbon based cleaners. Currently there is an evolution away from inks which where designated Class 3 to canola based inks which are unclassified under the WHMIS or Transportation of Dangerous Goods Acts. Some printers have changed from the ink process to photographic processes. The move from ink processes or classified inks to canola based inks has taken place among the larger volume printing facilities. This trend is predicated on changes in final product demand and/or a desire to use a smaller volume of hazardous materials in the production process. The level of awareness of hazardous chemicals varies considerably between operations. The WHMIS process has been adopted

by many of the operators, who seem to have a good understanding of the necessity and requirements of the processes surrounding the handling and use of regulated chemicals.

The generalized process for all involved in this classification is the application of various chemicals to paper products to produce printed documents or an image. The raw materials consist of paper and various chemicals, the quantities of which are presented in Table 3-6.

Chemicals are usually received in manufacturers containers ranging from 20 litre cubes to 205 litre drums. One major operator receives ink in bulk and stores the inks in large above ground tanks. The handling of the raw materials appears to pose little threat to the Regina aquifer because of the small volumes of the containers and the fact that they are generally stored and handled inside warehouse type buildings.

.3 Waste Handling

The major area of concern in this industry grouping arises because of waste handling and disposal procedures.

The printers tend to place a high percentage of their chemicals on the paper in the form of print, thus the primary waste product is a mixture of ink and the cleaning fluids which are used to cleanse the equipment prior to the next production run. Generally the

TABLE 3-6

COMMERCIAL PRINTERS AND PHOTOGRAPHIC DEVELOPERS
CHEMICAL INVENTORY
REGINA AQUIFER REGION, 1989

CLASS	STOCK	ANNUAL	WASTE	RECYCLED
2	100 l	1000 l		
3	10,000 l	21,960 l	51,000 l	200 l
4	380 l	3,000 l		
8	840 l	13,100 l		
9	40 l	600 l		

Totals based on 6 printers and 3 photographic developers

larger volume printers collect the waste fluids, which vary from kerosene to naphtha mixed with inks, from the cleaning process. This waste is considered a Class 3 flammable liquid. Historically this material has been hauled to the landfill and dumped or in the case of the lower volume printers the material is discharged to the domestic drain or discarded as refuse which is ultimately disposed of in the landfill.

.4 Potential Environmental Risk

The major potential for interaction with the environment is a result of the waste handling procedures. The operators who do store the waste ink and cleaning fluids are having difficulty finding recyclers or companies who will handle and dispose of the material, primarily because the volume of material being produced is not great enough to make it economical to handle on a regular basis.

This has led to disposal practices which are not desirable and in the long term are likely to impact on the environment and ultimately the ground water resource.

3.2.7 Autobody Repair and Paint Shops

.1 Introduction

The data presented in this part of the report was accumulated from interviews with 62 separate operations. The majority of the operations employ 4-5 individuals with a few having as many as 40 employees. The primary activity is the repair and repainting of

car bodies damaged by accidents or corrosion. Some of the shops also carry out mechanical repair but this is a minor activity in this group.

.2 Process

The primary chemicals used by autobody repair and paint shops are paints and solvents. An estimated 95% of the paint volume is consumed during application to the repaired surface. It is estimated about 5% of the paint becomes waste. The solvents which are used primarily in preparation and clean up become waste once contaminated with paint and other solids. About 90% of the solvent by volume becomes waste and an estimated 10% is lost through evaporation. The volume of chemical in storage and annual consumption for this industry is illustrated in Table 3-7.

.3 Waste Handling

Handling of waste materials in this industry is poor. About 130,000 L of class 3 waste is produced per year (Table 3-7). It is estimated that about 41% (53,000 L) of this waste is dumped in the vicinity of the operation or sent to the landfill.

About 41,000 L of solvents are recycled either through arrangement with a recycling company or through on-site solvent extraction systems. On-site solvent purification systems exist in only 8% of

TABLE 3-7

AUTOBODY AND PAINTING SHOPS CHEMICAL INVENTORY
REGINA AQUIFER REGION, 1989

CLASS	STOCK	ANNUAL	WASTE	RECYCLED
2	20,000 L	2500000 L		
3	36000 L	275000 L	130,000 L	50000 L

Totals based on 62 autobody and paint shops

the businesses. A large portion of the solvent waste stream is stockpiled at the originating site. On-site inspections revealed most businesses had a stockpile of solvent waste equalling about 21% of their annual consumption.

.4 Potential Environmental Risk

This industry poses a threat to the Regina aquifer. Some of the operators are disposing of waste improperly. It is estimated that 53,000 L of solvent and paint are being discharged to the ground annually. This material could eventually seep into the groundwater system and be dispersed by groundwater movements. Low levels of contamination could make the groundwater resource unusable.

3.2.8 Transportation Industries

.1 Introduction

The transportation grouping includes the airlines, the bus service and some rail services. The primary chemicals of concern with this group are fuels and lubricants.

The 12 companies making up this group include commercial and charter air carriers and their associated service facilities. The commercial bus services and the rail car cleaning and repair facilities are also within this grouping. The primary activity of this group is the provision of transportation services for goods and people.

.2 Process

The operators in this grouping tend to consume most of the chemicals in the process of providing their service. The volume of chemical in storage, particularly Class 3 fuels (Table 3-8) is large. Tankage consists of both above and in ground storage. The fuels are transferred from bulk trucks to storage tanks. From storage, fuels are drawn into service trucks which transfer the fuels to the appropriate vehicle. In the case of the surface transportation, fuels are pumped directly from bulk storage into the vehicles.

The railway operations included in this group primarily service railcars. The chemicals handled by these operations are residuals which are removed from the railcars between in-service periods. They also use solvents in their painting and coating operations.

The airline industry includes external use of chemicals for preparation of facilities and aircraft during winter months to ensure safe operation.

.3 Waste Handling

All of the operators produce waste in the servicing of the vehicles. The wastes are usually in the form of used lubricants from engines and hydraulic systems. These materials are collected, stored and recycled. The airline industry uses several chemicals for de-icing. One, which is basically a commercial fertilizer, is used for runway

TABLE 3-8
TRANSPORTATION INDUSTRY CHEMICAL INVENTORY
REGINA AQUIFER REGION, 1989

CLASS	STOCK	ANNUAL	WASTE	RECYCLED
2	10000 L	200,000 L		
3	927,000 L	36,650,000 L	96,000 L	96,000 L
6	203 L	5400 L		
9	1000 kg	13,000 kg		

Totals based on 12 transportation industries

preparation and the other, an antifreeze, is sprayed on aircraft to remove frost and ice during cold weather. These chemicals are released directly into the environment.

The railway operations collect residual petroleum products which are stored and recycled. Compressed gases are flared to the atmosphere, other chemicals are discharged to the domestic sewer system with wash water.

.4 Potential Environmental Risk

The major opportunity for hazardous chemical interaction with the groundwater system is in relation to the possible spill or leakage of Class 3 chemicals from storage tanks. The businesses which comprise this group utilize bulk storage systems for fuel which involves above or underground tanks and truck mounted tanks. There is a mix of spill prevention technology in use by the operations. The above ground storage poses less threat than the underground storage as visual inspections easily detect spills. Some of the underground storage is a threat primarily because of the age of the tanks. Some were installed 40 years ago.

None of the underground storage has adequate monitoring systems. Even the facility with the best spill containment system has some risk. Although the system is capable of containing a major fuel spill, if a spill occurred concurrent with a severe rainfall event the system would overflow to the city storm sewer system.

Small amounts of chemicals are discharged regularly from most of these operations during routine housekeeping activities. This is inherent throughout the industries which involve servicing and lubricating vehicles. In addition a variety of chemicals are discharged to the sewer system by several of the operators which utilize steam cleaning systems to prepare vehicles for repair or prior to return to service. The rinsed material is discharged to the drains, although some of the solid material is retained in sumps which are cleaned out with vacuum trucks.

3.2.9 Auto Service Sector

.1 Introduction

This grouping includes 8 shops which specialize in engine and chassis lubrication. The chemical totals do not include service stations which will be addressed in a separate report. The service centers are widely distributed but tend to be located on main traffic routes.

.2 Process

Operating procedures are common to all establishments. The various operators keep an inventory of lubricants in bulk and small plastic containers.

Hot oil is drained from the vehicles being serviced, the chassis is lubricated if appropriate and the oil filter is replaced. The primary wastes are used oils, with small volumes of solvent and

degreasers. The level of stock is about 8,000 litres/location. (Table 3-9) Total annual consumption is in excess of 350,000 litres. The accumulated waste oil volume is 329,000 litres, which is all recycled.

.3 Waste Handling

All waste oil is caught in a rolling tub which drains directly into an outside underground tank. This collection system is common to all the auto service operations surveyed.

Each auto service station has two tanks, one to catch waste oil and the other to hold new oil. When the supply tank comes to fill the new oil tank they empty a compartment on their trailer and fill it with the waste oil generated by the service station. The oil recyclers are not interested in small generators of used oil. Garage or vehicle repair stations or other small volume generators are not compensated for their waste oil and do not have the same access to waste oil handlers as does a large generator. Therefore disposal by small service stations is a concern because the final destination of the waste oil is unknown.

The oil filters generated by the engine and lubrication sector are all sent to the municipal landfill.

TABLE 3-9
AUTO SERVICES CHEMICAL INVENTORY
REGINA AQUIFER REGION, 1989

CLASS	STOCK	ANNUAL	WASTE	RECYCLED
3	64,570 L	353,000 L	329,000 L	329,000 L

Totals based on 8 auto service centres

.4 Potential Environmental Risk

The risk to the groundwater resource from the operations which specialize in engine and chassis is low. The volume of stored oils is small and even the bulk storage containers are of small volume, such that a leak is unlikely to be significant. The methods used for collection of wastes are well established and the volume of waste, provides an economic incentive to collect and recycle the waste oils. Releases from large volume used oil generators, to the environment are primarily limited to residuals washed from the floor of the operations during the daily clean up period.

Small volume generators of used oil find it difficult to dispose of their waste oil because it is of little interest to the recyclers. Therefore this oil could be a threat to the environment depending upon the disposal method.

3.2.10 Dairy and Beverage Industry

.1 Introduction

The City of Regina has four operations in this category. They tend to be major water users for both process and clean up. Their products are for human consumption and as such they tend to utilize chemicals for sanitation and water treatment. Operations consist of a product line where the particular commodity they provide is packaged, warehoused and distributed.

.2 Process

The process details vary depending upon the particular product, but the basics are the same throughout the industry. All require good quality water and therefore utilize a water treatment system to treat local domestic water to meet their own specifications. The operators either blend various materials to create product or transport bulk product in for treatment. The particular product is packaged and then distributed to retailers.

The bulk of the Class 3 (Table 3-10) chemicals are fuels consumed in the distribution process and the Class 2 chemicals are compressed gases consumed in the repair and maintenance of the operations.

.3 Waste Handling

In this industrial grouping recycling predominates on the solid waste side. Water treatment chemicals are consumed in the process and the sanitization chemicals are disposed of to the sanitary drains. Some of the sanitization chemicals can be reused and are stored in bulk tanks between cleansing of the product line. Thus all of the chemicals designated as Class 8 and 9 (Table 3-10) are utilized in the system and eventually end up in the domestic sewer system.

TABLE 3-10
DAIRY AND BEVERAGE INDUSTRY CHEMICAL INVENTORY
REGINA AQUIFER REGION, 1989

CLASS	STOCK	ANNUAL	WASTE	RECYCLED
2	30 m^3	30 m^3		
2	5500 L	30000 L		
3	100000 L	1210000 L	10000 L	
8	10000 kg	86000 kg		
8	46000 L	500000 L		
9	5000 kg	15000 kg		
9	400 L	3000 L		

Totals based on 4 operations

.4 Potential Environmental Risk

The risk from this industry is considered low relative to other industries. Bulk chemical storage is above ground. Therefore a leak of chemicals from these tanks would be detected quickly and should be rectified readily.

The only other area of concern is the sanitization chemicals. The concentrations of these particular fluids are such that they pose little threat to the environment.

3.2.11 Industrial Manufacturers

.1 Introduction

This particular designation involves a broad range of businesses including: primary manufacturers who produce the raw materials for other manufacturing operations, and secondary manufacturers which utilize metals and plastics and produce finished products for the agricultural or commercial business sectors. Some of the members of this grouping also service the equipment they manufacture. This survey included eleven industrial companies.

.2 Process

The process generally involves introduction of raw material into a process which may involve heating, molding, pressing, cutting and welding and/or assembly. The final product in all of these businesses is then resold to be used by other industries or the final user. A variety of chemicals are used in these processes

including lubricants, solvents, corrosive liquids, compressed gases and paints (Table 3-11).

.3 Waste Handling

The chemical consumption of this group varies considerably with the type of operation. The primary manufacturers tend to consume large quantities of hazardous materials and produce a large volume of Class 3 waste. The secondary manufacturers utilize smaller quantities of hazardous chemicals. Their waste products tend to be paper, metals or plastics most of which are recycled. This group is the largest user of compressed gases. They tend to be consumed in the manufacturing process and do not pose a threat to the aquifer system.

The use of Class 3 chemicals are primarily paints and solvents utilized in the preparation cleaning and maintenance of equipment or product.

One operator in this group produces a large waste oil stream which is used as a dust suppressant material.

The group produces about 130,000 L of waste solvents and paints of which only 10,000 L are recycled. Several of the manufacturers have to store the chemicals in drums until adequate volumes are accumulated for disposal.

TABLE 3-11
INDUSTRIAL MANUFACTURERS CHEMICAL INVENTORY
REGINA AQUIFER REGION, 1989

CLASS	STOCK	ANNUAL	WASTE	RECYCLED
2	3364000 L	10234000 L		
3	89600 L	4582000 L	130500 L	10000 L
6	7000 L	7000 L		
8	3000 L	6000 L		
9	200 L	202500 L		

Totals based on 11 industrial manufacturers

.4 Potential Environmental Risks

The risk to the aquifer is limited. Co-ordinated disposal of waste solvents could decrease this risk further. Waste storage tends to occur in drums in uncovered storage facilities. Elimination of the use of waste oil as a dust suppressant in the study area would decrease the environmental risk, especially when large volumes of oil are involved and the area is environmentally sensitive.

3.2.12 Institutional Facilities and Laboratories

.1 Introduction

This group includes educational, medical and research facilities and laboratories. The range of chemicals used is broad although volumes are small. This grouping included six institutional facilities.

.2 Process

The chemicals are generally used in small quantities for research or investigative purposes in laboratory situations. Most of these chemicals are used only a few millilitres at a time, and are usually diluted and discharged to the domestic sewage system. The only substance maintained in large volume is fuel for emergency generators. This shows itself in Table 3-12 where the stock of Class 3 maintained at the facilities is much greater than the annual consumption.

.3 Waste Handling

The process and procedure varies between institutions. Most of

TABLE 3-12
INSTITUTIONAL FACILITIES CHEMICAL INVENTORY
REGINA AQUIFER REGION, 1989

CLASS	STOCK	ANNUAL	WASTE	RECYCLED
3	108000 L	35000 L	4200 L	50 L
6	117 L	117 L	13200 kg	
8	10000 L	11000 L	400 L	
8	1200 kg	6200 kg	500 kg	
9	1 kg	1 kg	10000 L*	

Totals based on 6 institutional facilities
* This mainly represents disinfecting solutions.

the chemicals tend to be consumed in the process. One of the facilities which generates about 2500 L of solvents found their volumes were of little interest to recyclers. They designed and constructed a solvent evaporation tank which has worked satisfactorily for their purpose. The solid residue from this process is landfilled. Hospitals and medical clinics in general have poor waste management practises. In many operations medical waste is treated as municipal waste.

Recycling is of interest to most of the institutions however to date it has been limited to a small volume of lubricating oil and paper wastes.

The institutions also generate biological wastes (Class 6) which requires special handling procedures. This material tends to be stored, consolidated and when volume warrants, it is transported to a licensed waste handler for destruction. Most infectious waste is incinerated in one central location in the City of Regina. However, due to the volumes involved, the capacity of this facility has been exceeded, and some of the material has been landfilled.

.4 Potential Environmental Risk

The risk to the aquifer comes from three sources. There is normal risk associated with underground fuel storage. Consideration should be given to a more sophisticated monitoring system for underground storage tanks. Care should also be taken to ensure

laboratory and photographic chemicals are properly neutralized and/or diluted before being disposed of in the domestic sewer system. The effects of sending biomedical waste to a landfill have not been determined.

3.3 Chemical Inventory Distribution

The total volume of hazardous chemicals in use in the Regina Aquifer region is presented in Table 3-13. The distribution of these chemicals is presented in Appendix B Figures B-1 - B-7.

The classified chemicals tend to be concentrated in the northeast section of Regina, which is also where the majority of the spills have taken place.

3.4 Spills

The spills that occur in Regina and the surrounding Rural Municipalities consist of underground and above ground tank leakages, tanker spills, pipeline breaks and overflow problems. The bulk of the spills are classified petrochemical (class 3) and sewage spills (class 9). Petrochemical spills are more common but usually of smaller volume than the sewage spills. Sewage spills have generally been >10,000 L. Sewage spills are commonly the result of a buried pipeline break. Maps depicting the spill volumes and general location and chemical class are provided in Appendix C.

TABLE 3-13

TOTAL VOLUME OF CHEMICALS ENCOUNTERED DURING SURVEY

REGINA AQUIFER REGION, 1989

CLASS	STOCK	% OF TOTAL	ANNUAL	% OF TOTAL	WASTE	RECYCLED
2	1403818 L	0.8	158042706 L	4.9	-	-
3	153142703 L	89	2999921615 L	93	788050 L	488850 L
4	198907 L	0.1	270696 L	0.008	-	-
5	16025 L	0.009	62745 L	0.002	-	-
6	10059556 L	5.8	30092990 L	0.93	13200 kg	-
8	6046619 L	3.5	17949036 L	0.55	454400 L	-
					700500 kg	700000 kg
9	820028 L	0.5	13626777 L	0.42	3287400 L	-
					65000000 kg	62000000 kg
	171687656 L	100	3219966565 L	100	TOTALS 70243550	63188450

Totals based on 169 questionnaire responses

3.5 Landfills and Lagoons

.1 Introduction

There are a variety of sites in the Regina region used for disposal and/or treatment of sewage, domestic and industrial waste. Treatment of domestic solid waste and non hazardous industrial waste is generally limited to accumulation and burial at landfill sites. Sewage is generally collected and deposited in lagoons at various locations in the region. The City of Regina maintains a major lagoon and treatment system with discharge to Wascana Creek and ultimately to the Qu'Appelle River system.

.2 Process

The eighteen active landfill sites (Appendix D) are controlled under the provincial Municipal Refuse Management Act. These sites are supposed to be designed to limit access and to control deposition of materials by type and location. The largest landfill is the City of Regina's, northeast of the city limits. The other sites tend to be small sites servicing local villages and rural residents. The City of Regina site is supervised, while the rural refuse sites tend to be less regulated although all have signs indicating limits of use.

The sewage lagoons are widely distributed throughout the region (Appendix D, Figure D-1). They vary from a large multicell system occupying several quarter sections of land to one or two cells occupying 10-20 acres. Properly sited and constructed sewage lagoons pose little threat to the Regina aquifer. Several of the rural lagoons are known to be leaking and an active program

between the province and the municipalities is underway to bring the existing lagoons up to required operating standards.

.3 Waste Handling

An unknown volume of hazardous chemicals is being disposed of at the various landfill sites and in the domestic sewage system. In many cases, the inappropriate disposal methods are due to a lack of understanding of the risks certain materials pose for the environment and/or to a lack of practical alternatives for disposing of small volumes of waste or residual hazardous chemicals. The actual volume and disposal location of various chemicals is unknown. This survey indicated that a considerable percentage of chemical waste is being deposited in the landfill system.

.4 Potential Environmental Risk

The volume and variety of chemicals which are being disposed of in the landfill system create a significant risk for the Regina aquifer system. Contamination of the aquifer could make it unusable. The primary risk is from hydrocarbon solvents, acidic and basic material and waste oils.

Sewage lagoons could also impact the Regina aquifer. Several lagoons are situated in less than ideal locations and although movement of leached materials is considered to be limited at present, they may pose a long term threat to the groundwater resource.

3.6 Waste Handlers and Recyclers

.1 Introduction

This grouping includes a variety of organizations using various methods to dispose of or recycle waste chemicals. Eleven businesses are grouped under this heading, it includes oil recyclers, battery salvagers, PCB decontaminated oil processors, and organic liquid refiners.

.2 Process

The oil recyclers recover used lubricants and process them for reuse, separating contaminants and usable product which is packaged for resale to the consumer.

The battery salvage operations recover metals such as lead from the batteries or in some cases clean and recharge the battery for reuse. This process generates wastes particularly used acid which must be collected and neutralized before disposal. There were indications that some operators may not be using appropriate disposal procedures.

The PCB decontamination process involves separating and neutralizing PCB's from transformer oil. The PCBs are extracted then broken down and transformed to a state which can be disposed of through another disposal firm, while the oil is recycled. The decontamination process substantially reduces the volumes of material which requires special treatment.

The classes and volumes of chemicals handled by this group are illustrated in Table 3-14.

.3 Waste Handling

This group's source of feedstock is waste from other industries. Their processing activities reclaim a usable fraction and produce new waste streams. The operations vary from two man "backyard" situations to well equipped modern facilities with well trained staff equipped to handle hazardous chemicals.

The small adhoc operations are difficult to regulate. Approaches to storage and disposal of chemicals vary significantly and are not well defined. The higher profile organizations are well regulated and have well established procedures for the handling of hazardous materials.

.4 Potential Environmental Risks

The risk to the Regina aquifer is directly related to the improper handling of the raw waste and/or the disposal of the residual wastes. The concern arises because these operations can be set up unnoticed and as a result unregulated. An operator may salvage a portion of the waste and then dump the residual waste without realizing the consequences.

This sector in particular requires further investigation, to ensure that proper waste disposal procedures are acknowledged and implemented.

TABLE 3-14

RECYCLERS AND HANDLERS
ESTIMATED TOTAL HAZARDOUS CHEMICAL VOLUMES
REGINA AQUIFER REGION, 1989

CLASS	STOCK	ANNUAL	WASTE	RECYCLED
3	136940 L	1316940 L	1307540	1307000
4	3192 L	31921 L		
4	1450 kg	1450 kg		
8	19506 L	65713 L		
9	661200 L	661200 L		

Totals based on 11 recyclers and handlers

4.0 CONCLUSIONS

4.1 Introduction

This study was undertaken to provide insight into use of hazardous chemicals in the Regina region. This involved documentation of the types of chemicals, the volumes, waste disposal methods and general distribution. One hundred and sixty-nine separate organizations were contacted and surveyed. We feel the survey although not complete included a large proportion of the major hazardous chemical users and provides a good representation of the practices related to hazardous chemical use in the Regina Aquifer region. The conclusions which we present in our report are subjective based upon the perceptions acquired during the course of the survey.

4.2 Conclusions

The Petrochemical Industry poses the greatest risk to the Regina Aquifer. A variety of factors contribute to this conclusion. This industry maintains the largest volume of hazardous chemicals (Class 3) on both a daily and annual basis. They have a history of large spills for which remediation is difficult. Although the chemicals are distributed widely throughout the Regina region the area of greatest risk occurs in northeast Regina, where pipelines and a refinery maintain large volumes of Class 3 chemicals in tank farms. These activities occur directly over the Regina Aquifer.

Two groups pose the next greatest risk to the aquifer. They are the Agricultural and Commercial Chemical suppliers. The greatest risk is from those which utilize bulk tanks for process and storage. These operations are also located in northeastern Regina.

A related part of this group is commercial and agricultural distributors who were rated as posing considerably less risk. The risk is less because although they do store large volumes of hazardous materials, the chemicals tend to be in small volume containers in a warehouse situation. A major impact on the aquifer is unlikely unless associated with another catastrophe such as a fire, flood or tornado.

A positive feature of both the agricultural and commercial chemical distributors was that the majority of operations had well established handling procedures for both product and waste materials.

The other groups in this survey pose considerably less threat to the aquifer primarily because of the relatively small volume of hazardous chemicals associated with the operations, and because they tend to be less concentrated. The operating groups in this category included, Dairy & Beverage Industry, Auto Service Sector, Transportation, Industrial Manufacturers, Livestock Operations, Commercial Cleaners, Commercial Printers and Photo Developers,

Autobody Repair and Paint Shops, and Institutional Facilities and Laboratories.

There are amongst these operations particular operations which maintain practices which are inappropriate. Several operators still practice "dumping" of liquid chemicals on their own property or the landfills. Others had "waste disposal" companies pick up their waste but were unable to identify the destination of their wastes. Some companies have been unable to secure appropriate disposal facilities, which has resulted in the stockpiling of wastes in poorly secured storage areas.

Landfills and lagoons if properly sited and operated would pose little risk to the aquifer system. However, field investigations during this study showed that the landfills in the region are receiving hazardous materials. These materials include: waste oil, acids, waste cleaning chemicals and solvents. This is due mainly to the fact that most landfills are loosely supervised in terms of what can be dumped. In some business groupings 20% of their hazardous waste would be sent to the landfill. To prevent hazardous waste materials from entering landfills would require careful scrutinizing of material being trucked in. Landfills under present regulations are not allowed to accept hazardous materials. To ensure landfills do not become sources of ground water contamination requires more stringent enforcement of present regulations.

Inactive landfills (presently two within the City of Regina see Figure D-2) need further study to determine what impact they could have on surrounding ground water resources. Difficulties in assessing their impact will center on the question of what was actually delivered to these sites. Further study would be required to provide an evaluation of the risk these sites pose to the Regina aquifer.

Several lagoons, sited in inappropriate locations, are a risk to the ground water system. More planning should be put into the location of these sites, and the possible consequences they could have with the ground water system if inappropriately located (see Appendix D for location of sites).

Table 3-13 shows that there are large volumes of chemicals located within the study area. This should be viewed as a conservative estimate as time did not permit inclusion of all firms that use hazardous materials.

The location of these materials is also a determining factor in the potential for interaction with the ground water system. Appendix B (Chemical Inventory Distribution Maps) shows that the majority of the chemicals are located in the northeast section of Regina, which is a recharge area for the aquifer system. This area would be at the greatest risk of having the ground water

impacted upon. That would be due to the large volumes of chemicals stored in that area and the types of industrial activity in that area.

Recyclers and their operations in general present a minor risk to the aquifer system. Primarily because the recycling industry in Regina deals with a small percentage of hazardous chemicals in Regina. The only relatively large stream of waste which may have some impact on the aquifer system is the stream of used oil. One industry is spreading used oil as a dust suppressant (approximately 100,000 litres/year) and these volumes impact the ground water resource.

A concern with the recycling industry is the variation in operating procedures. The well established and high profile recyclers who deal with wastes such as PCB's utilize well defined procedures. The recyclers dealing with everyday types of wastes, such as used batteries and used oil receive less scrutiny. This is reflected in an inconsistent approach to handling the waste, which causes the risk to be greater than it should be from these types of operations.

The approach to dealing with hazardous chemicals and waste generally varied more between groups than within groups. There was great divergence in approach within the chemical manufacturers and recycling groups.

This report lends itself to making several recommendations which would lessen the long-term risk of contamination of the Regina ground water resource. These recommendations include:

- regulations for industrial expansion as relating to the protection of the groundwater resource should be reviewed.
- building and safety regulations should incorporate measures to protect the aquifer in areas which are susceptible to contamination (i.e. impervious pads for above ground storage, spill detection for underground storage).
- the use of underground chemical tank storage should be discontinued in high risk areas or require appropriate monitoring equipment.
- industrial zoning should incorporate protection of the groundwater resource.
- building design criteria should be established for the warehousing of large volumes of hazardous chemicals.
- general education programs should be developed to demonstrate the environmental risk of improper hazardous waste disposal.
- a recycling or "bulking" program should be established to help small volume generators of recyclable hazardous waste.
- hazardous waste regulations need to be developed to ensure proper waste disposal and management, and also to ensure protection of the environment - Regina Aquifer.
- existing regulations need to be enforced at landfill sites.

APPENDIX A

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EXHIBIT A-1

File: W6-9-10

March 29, 1989

Dear Sir/Madam:

Regina Groundwater Project

The Water Quality Branch of Saskatchewan Environment and Public Safety is presently engaged in a groundwater study of the Regina area. The study is designed to develop future planning guidelines so that contamination of the Regina Aquifer can be controlled or prevented.

The Air and Land Protection Branch will be assisting the Water Quality Branch in identifying all industrial residents in the Regina Aquifer area. Your firm has been selected to partake in the survey and a member of the Department will be contacting you shortly.

The survey will take very little time, depending on your operations, and your co-operation will be appreciated. All information gathered will be treated as confidential.

If you have any questions, comments, or if you wish to designate a contact person, please contact Mr. Kyle Guderyan at 787-6412.

Yours sincerely,

L. J. Lechner, P. Eng.
Director
Air and Land Protection Branch
Phone: 787-6195

cc R. G. Ruggles

EXHIBIT A-2

Saskatchewan Environment & Public Safety

Air and Land Protection Branch

Regina Groundwater Project: Task 4 - Land Use Guidelines

Land Use Questionnaire

I. Company Data Date:

Company Name:

Address:

Contact Person:

Phone Number:

Title:

No. of years with Company:

Brief description of company's activities:

S.I.C.:

No. of years on site:

Starting date of operations:

Closure date if appropriate:

General:

II. Process Flowchart

Include input, output, waste and resource volume either by hour, day, week or month.

III. Hazardous Materials Inventory

* include MSDS if appropriate

Material	Raw Product	Finished Product	Waste	Stock (on hand)	Yearly Amount	Type of Storage	Spill Retainment

IV. Waste Handling Process

How is the waste disposed of both onsite and off?

Is the company registered as a hazardous waste generator, carrier or receiver?

Describe waste minimization processes in place.

Are waste recovery methods appropriate or possible?

Are there any difficult waste streams that have been encountered and how have they been handled?

V. Potential Impacts on the Environment

What is the spill history and what were the cleanup methods?

Are there any abandoned yard sites and what were the hazardous materials used on this site?

Can any hazardous materials be substituted in the present process?

List possible pathways of hazardous materials into the groundwater.

VI. General Comments

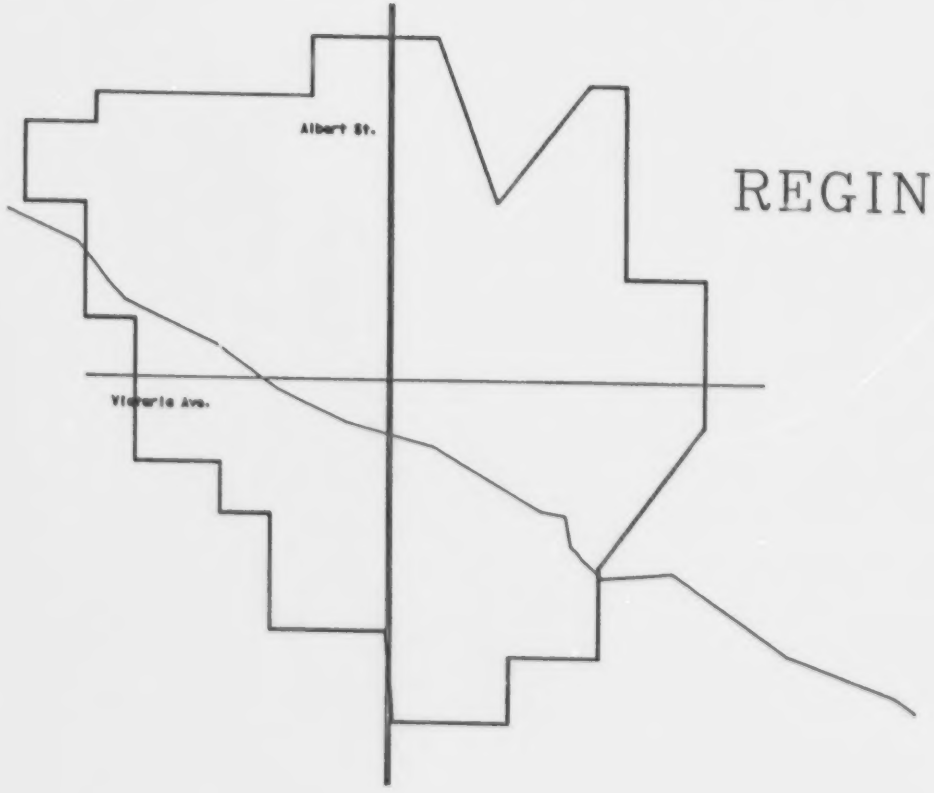


Figure A-3

BASE MAP

SASKATCHEWAN ENVIRONMENT

REGINA AQUIFER
HAZARDOUS CHEMICAL STUDY
1989

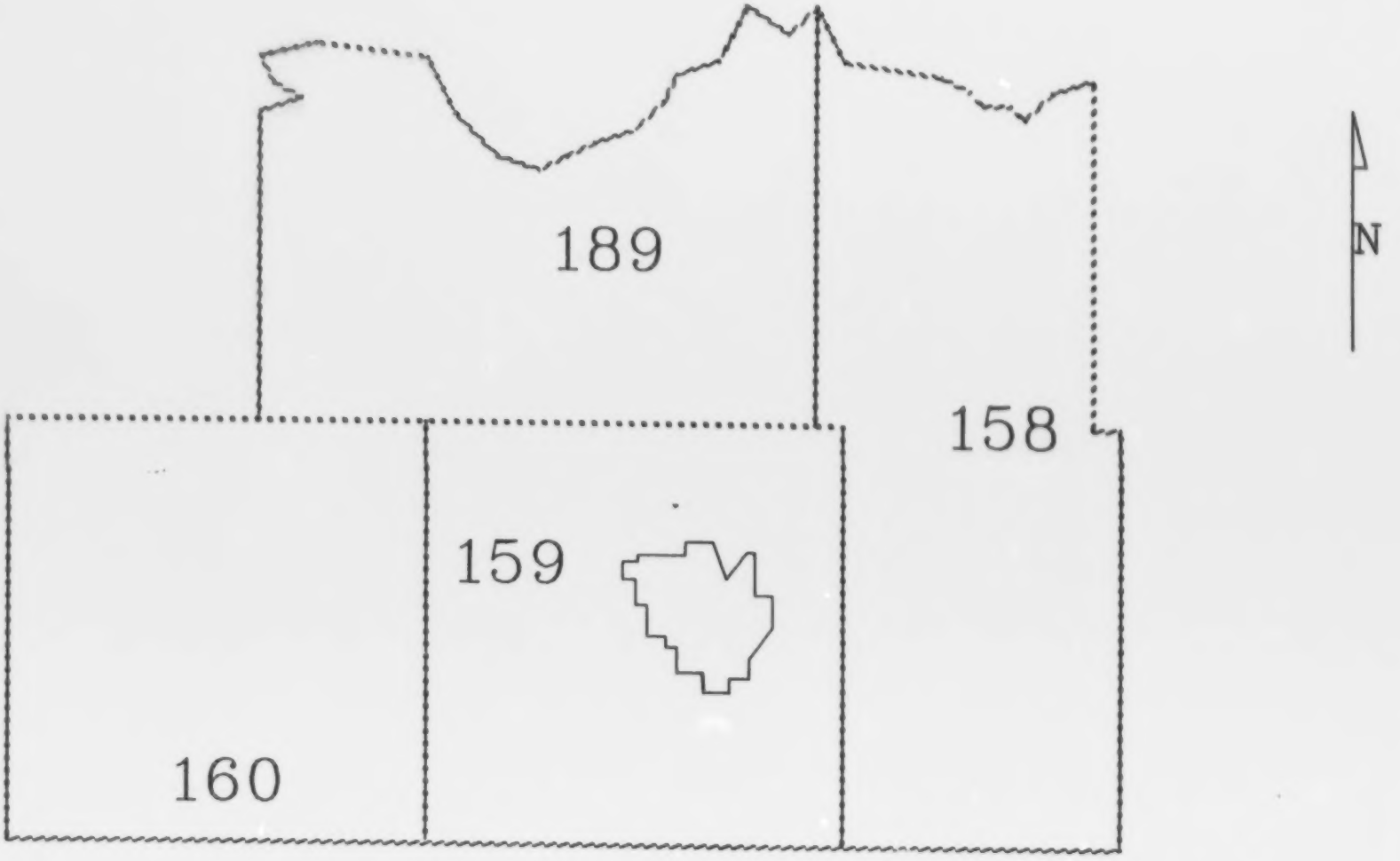
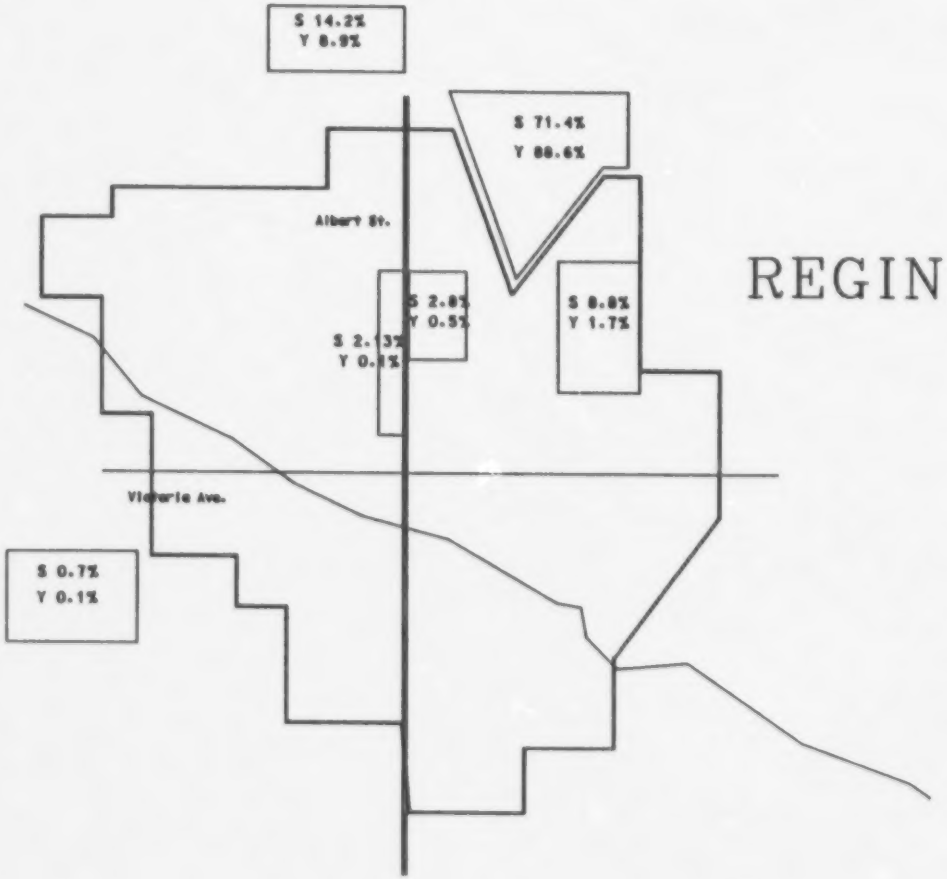


Figure A-4
STUDY AREA
SASKATCHEWAN ENVIRONMENT
REGINA AQUIFER
HAZARDOUS CHEMICAL STUDY
1989

APPENDIX B

CHEMICAL INVENTORY DISTRIBUTION MAPS

	PAGE
CHEMICAL INVENTORY DISTRIBUTION-CLASS 2	B-1
CHEMICAL INVENTORY DISTRIBUTION-CLASS 3	B-2
CHEMICAL INVENTORY DISTRIBUTION-CLASS 4	B-3
CHEMICAL INVENTORY DISTRIBUTION-CLASS 5	B-4
CHEMICAL INVENTORY DISTRIBUTION-CLASS 6	B-5
CHEMICAL INVENTORY DISTRIBUTION-CLASS 8	B-6
CHEMICAL INVENTORY DISTRIBUTION-CLASS 9	B-7

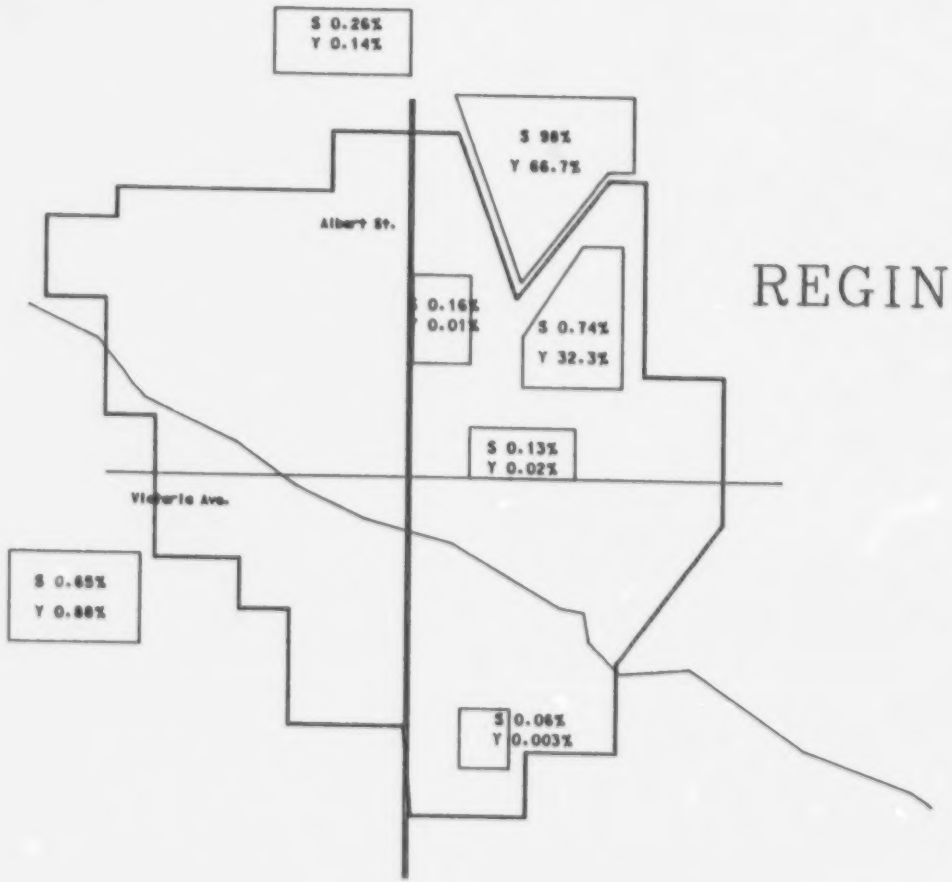


S - amount on hand
total volume: 1403818 L

Y - annual amount
total volume: 158042706 L

Figure B-1
CLASS 2
CHEMICAL INVENTORY DISTRIBUTION
SASKATCHEWAN ENVIRONMENT

REGINA AQUIFER
HAZARDOUS CHEMICAL STUDY
1989



REGINA

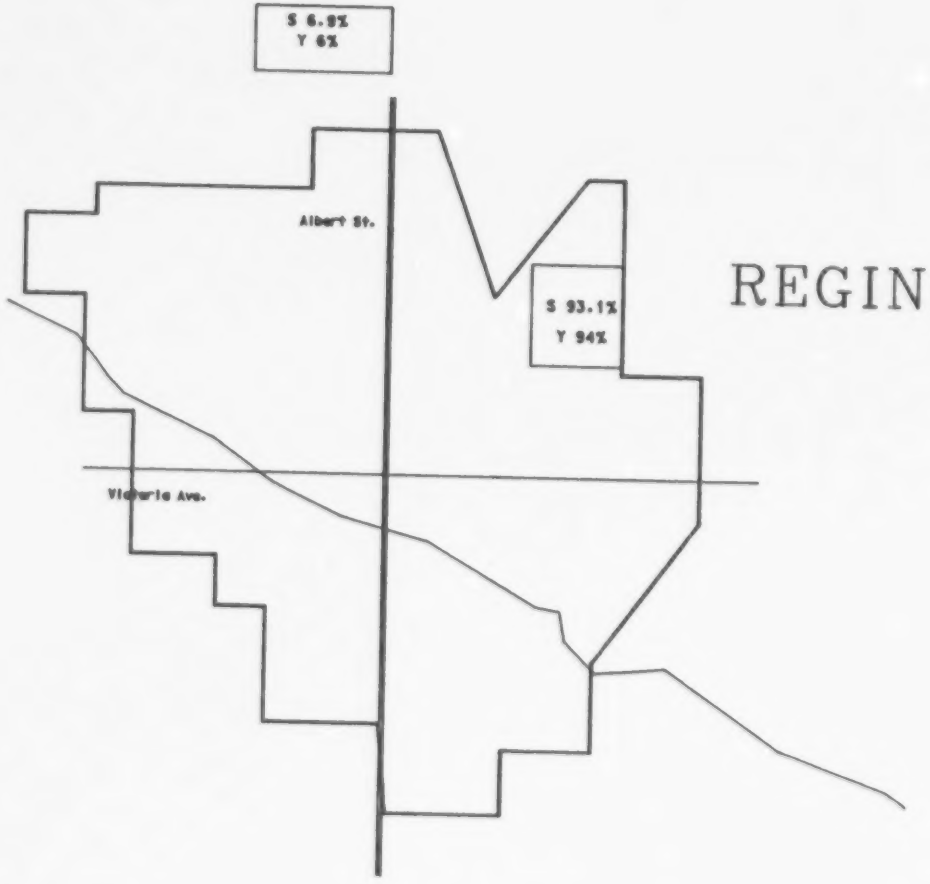
N

S - amount on hand
total volume: 153142703 L

Y - annual amount
total volume: 2999921615 L

Figure B-2
CLASS 3
CHEMICAL INVENTORY DISTRIBUTION
SASKATCHEWAN ENVIRONMENT

REGINA AQUIFER
HAZARDOUS CHEMICAL STUDY
1989



REGINA

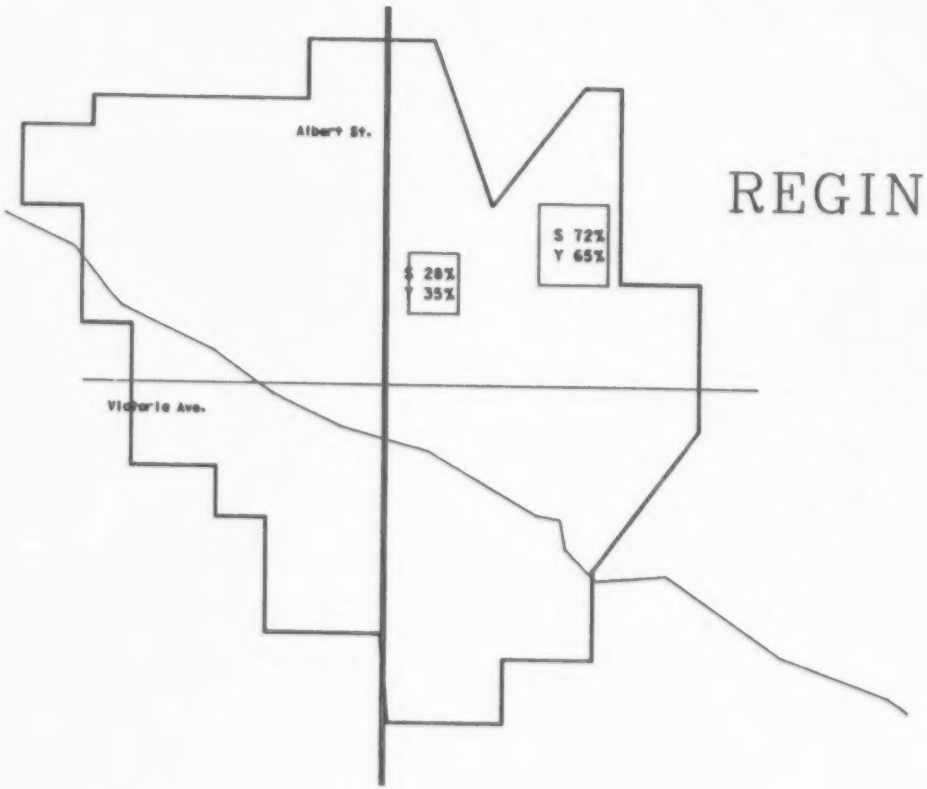
N

S - amount on hand
total volume: 198907 L

Y - annual amount
total volume: 270696 L

Figure B-3
CLASS 4
CHEMICAL INVENTORY DISTRIBUTION
SASKATCHEWAN ENVIRONMENT

REGINA AQUIFER
HAZARDOUS CHEMICAL STUDY
1989



REGINA

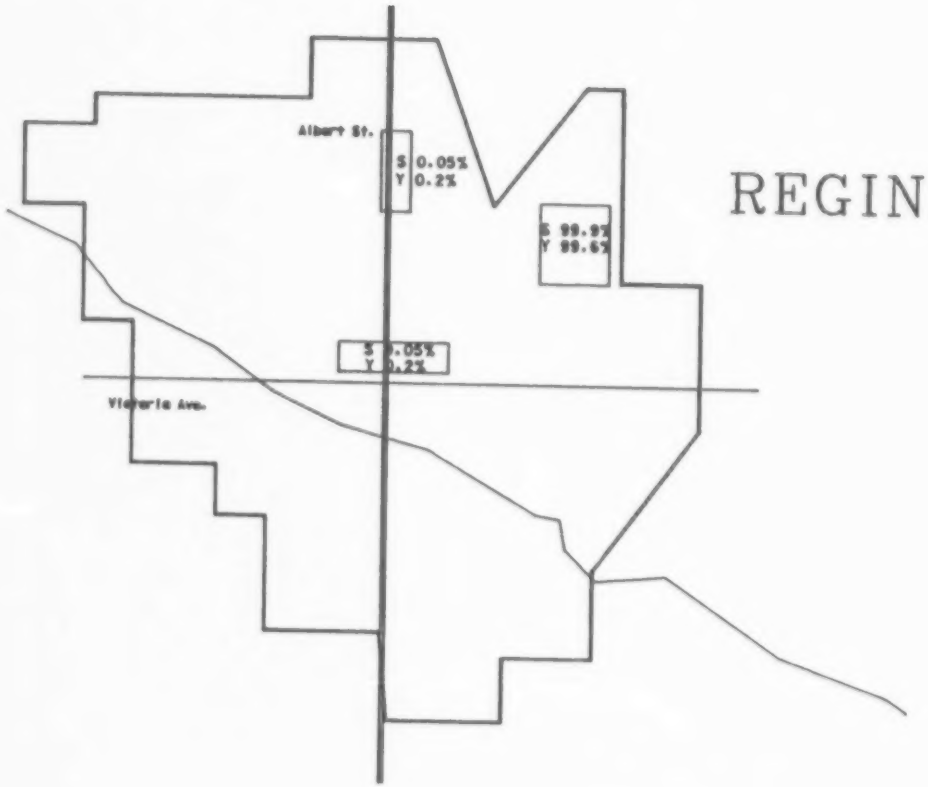
N

S - amount on hand
total volume: 16025 L

Y - annual amount
total volume: 62745 L

Figure B-4
CLASS 5
CHEMICAL INVENTORY DISTRIBUTION
SASKATCHEWAN ENVIRONMENT

REGINA AQUIFER
HAZARDOUS CHEMICAL STUDY
1989



REGINA

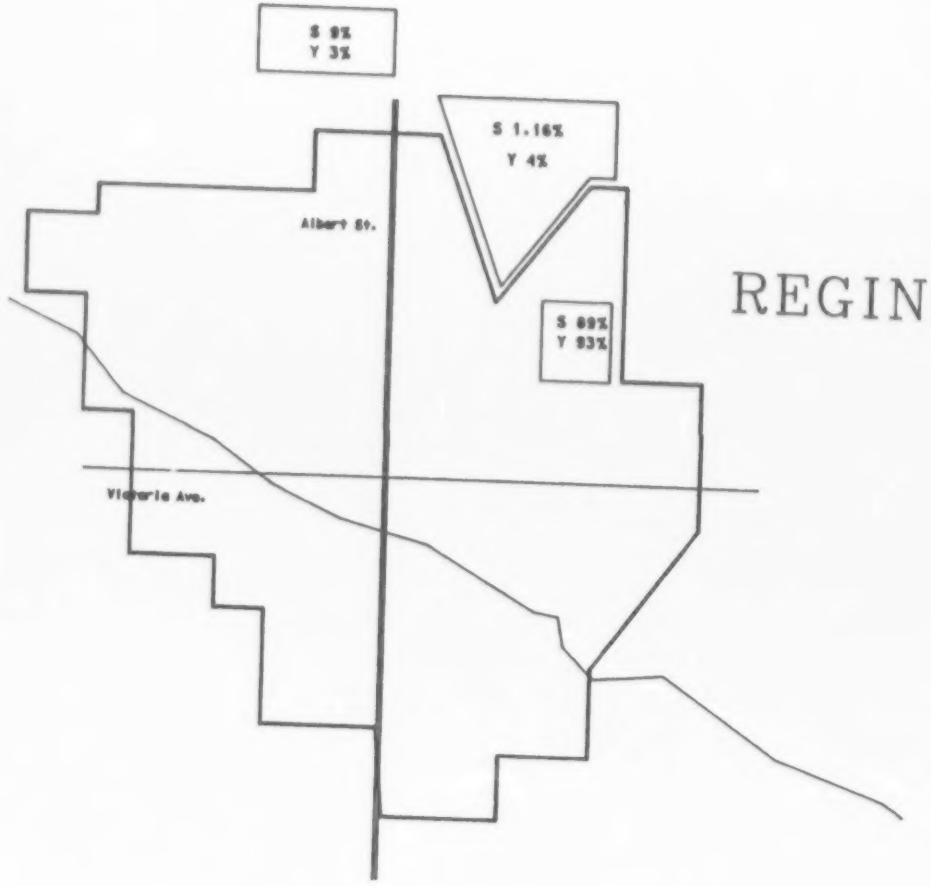
N

S – amount on hand
total volume: 10059556 L

Y – annual amount
total volume: 30092990 L

Figure B-5
CLASS 6
CHEMICAL INVENTORY DISTRIBUTION
SASKATCHEWAN ENVIRONMENT

REGINA AQUIFER
HAZARDOUS CHEMICAL STUDY
1989



REGINA

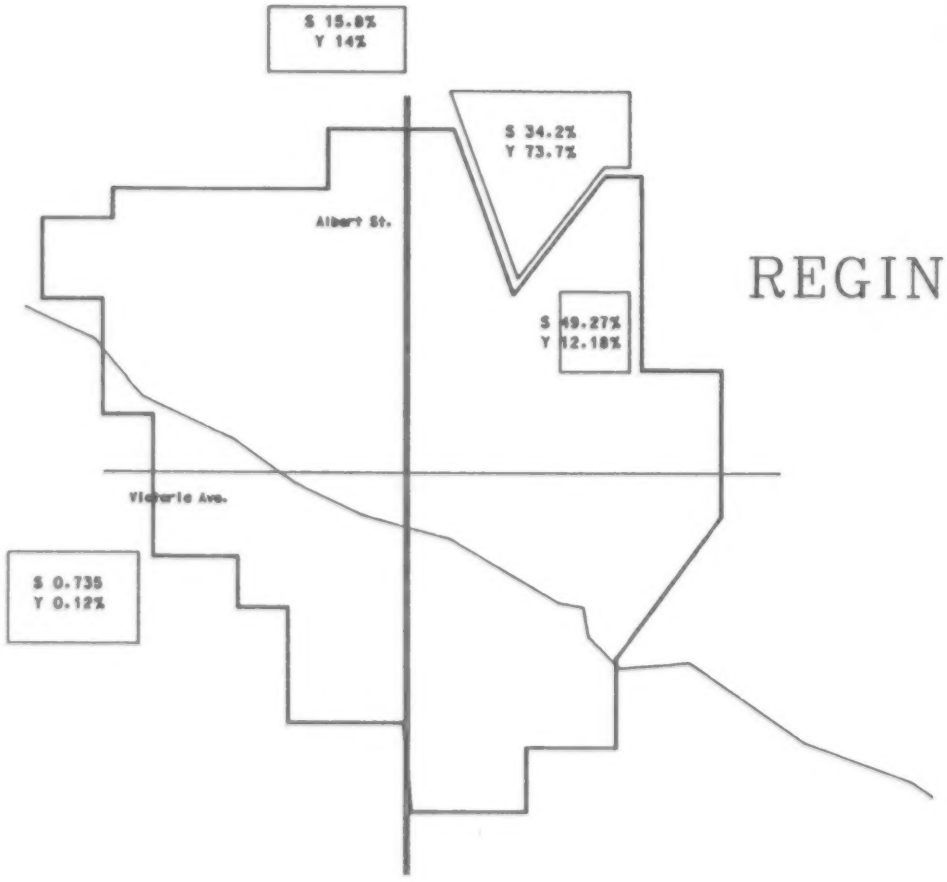
N

S - amount on hand
total volume: 6046619

Y - annual amount
total volume: 17949036 L

Figure B-6
CLASS 8
CHEMICAL INVENTORY DISTRIBUTION
SASKATCHEWAN ENVIRONMENT

REGINA AQUIFER
HAZARDOUS CHEMICAL STUDY
1989



REGINA

N

S - amount on hand
total volume: 820028 L

Y - annual amount
total volume: 13626777 L

Figure B-7
CLASS 9
CHEMICAL INVENTORY DISTRIBUTION
SASKATCHEWAN ENVIRONMENT

REGINA AQUIFER
HAZARDOUS CHEMICAL STUDY
1989

APPENDIX C

SPILL MAPS

	PAGE
SPILLS - CLASS 2	C-1
SPILLS - CLASS 3	C-2
SPILLS - CLASS 5	C-3
SPILLS - CLASS 6	C-4
SPILLS - CLASS 8	C-5
SPILLS - CLASS 9	C-6

SASKMONT ENGINEERING LTD.

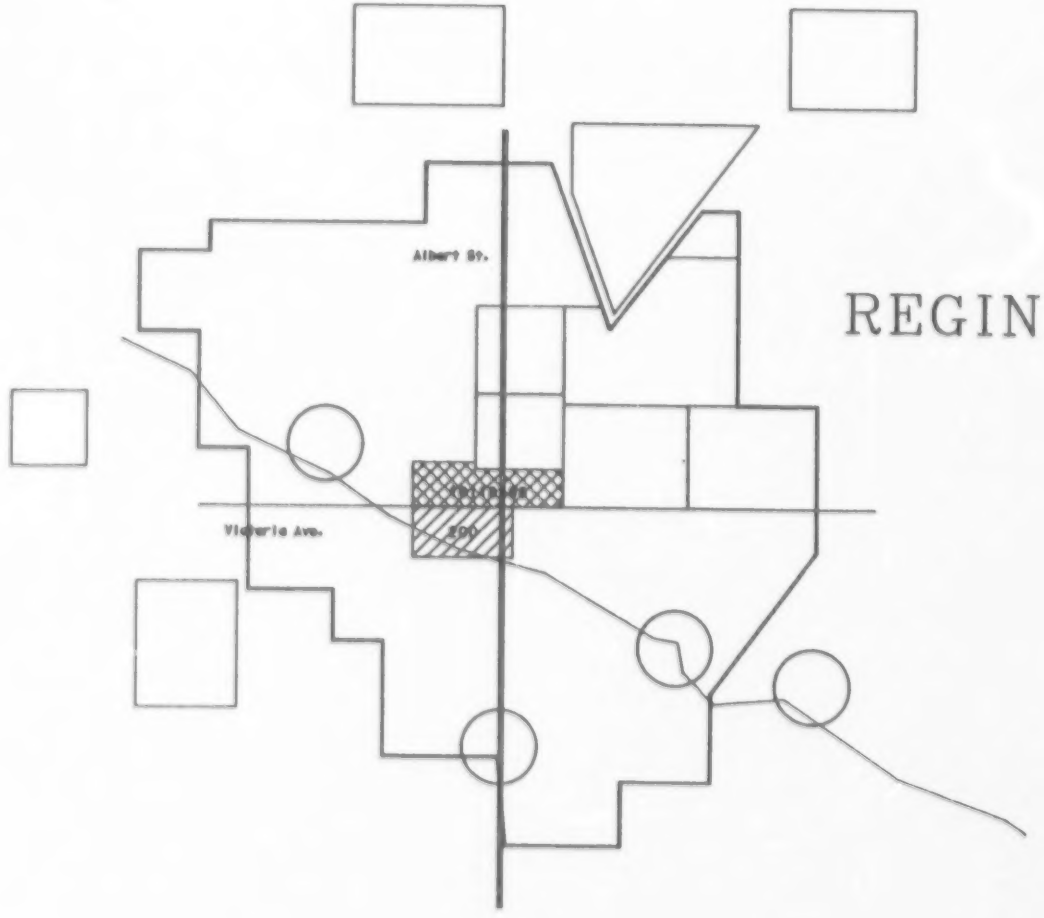


Figure C-1
CLASS 2 - SPILLS
SASKATCHEWAN ENVIRONMENT
REGINA AQUIFER
HAZARDOUS CHEMICAL STUDY
1989

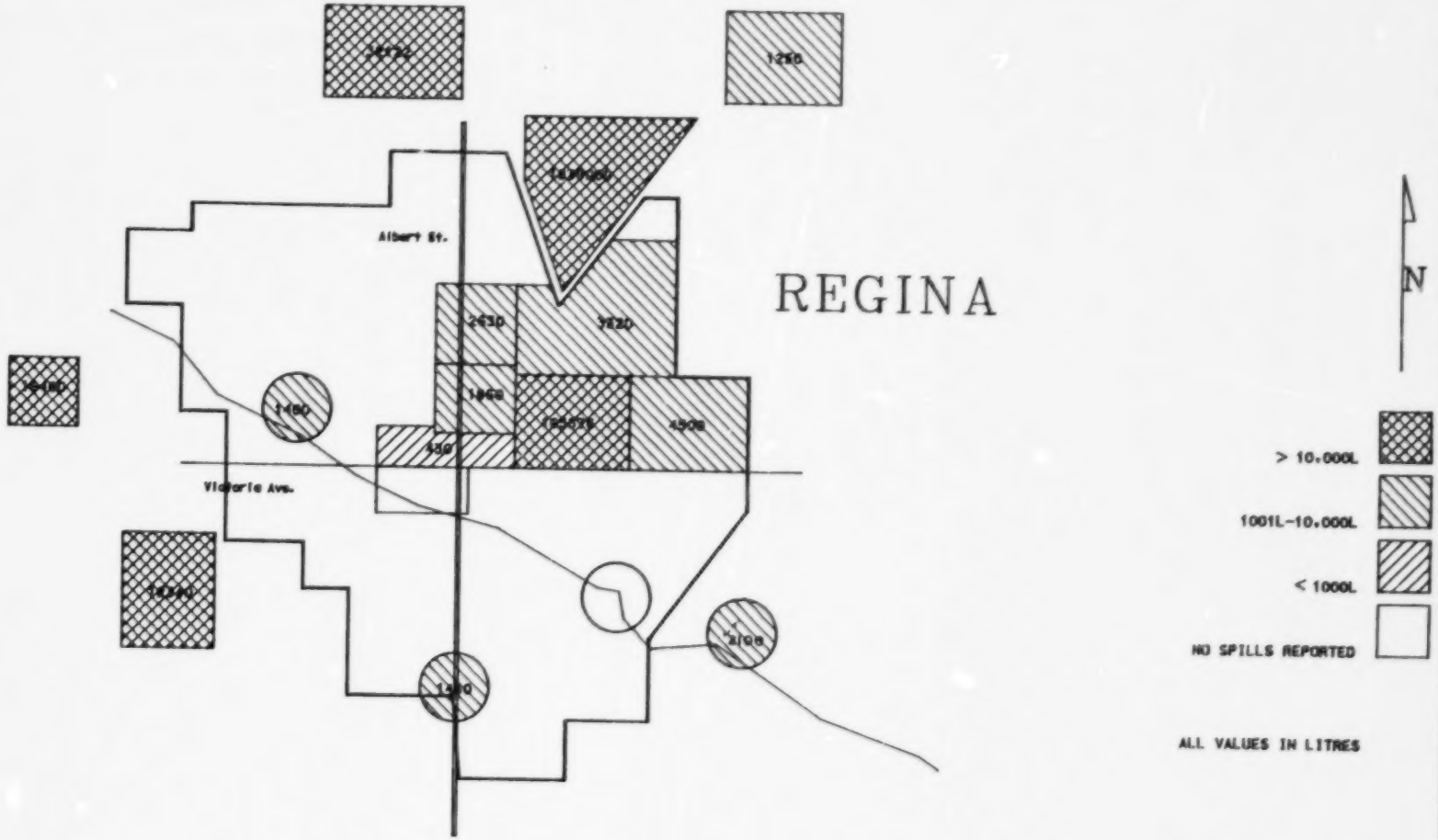
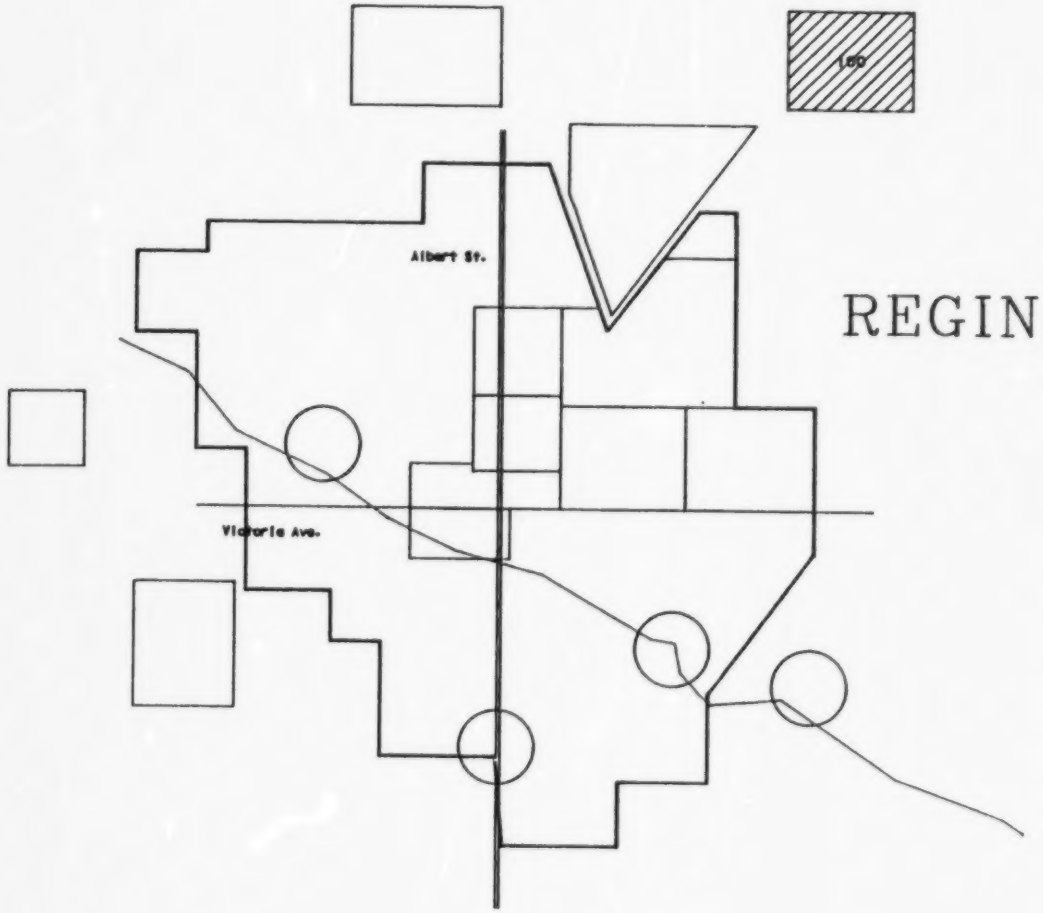


Figure C-2
CLASS 3 - SPILLS
SASKATCHEWAN ENVIRONMENT
REGINA AQUIFER
HAZARDOUS CHEMICAL STUDY
1989



REGINA

N

> 10,000L

1001L-10,000L

< 1000L

NO SPILLS REPORTED

ALL VALUES IN LITRES

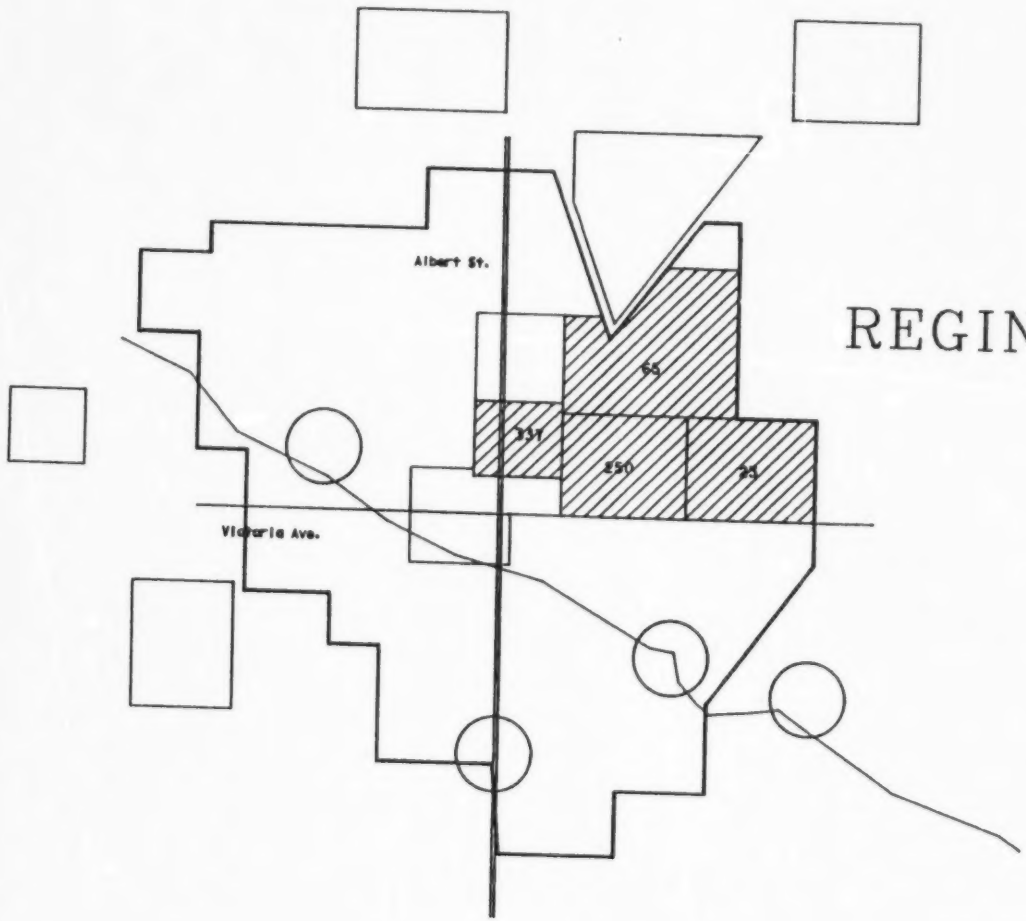
Figure C-3

CLASS 5 - SPILLS

SASKATCHEWAN ENVIRONMENT

REGINA AQUIFER
HAZARDOUS CHEMICAL STUDY
1989

SASKMONT ENGINEERING LTD.



REGINA

N

> 10,000L

1001L-10,000L

< 1000L

NO SPILLS REPORTED

ALL VALUES IN LITRES

Figure C-4

CLASS 6 - SPILLS

SASKATCHEWAN ENVIRONMENT

REGINA AQUIFER
HAZARDOUS CHEMICAL STUDY
1989

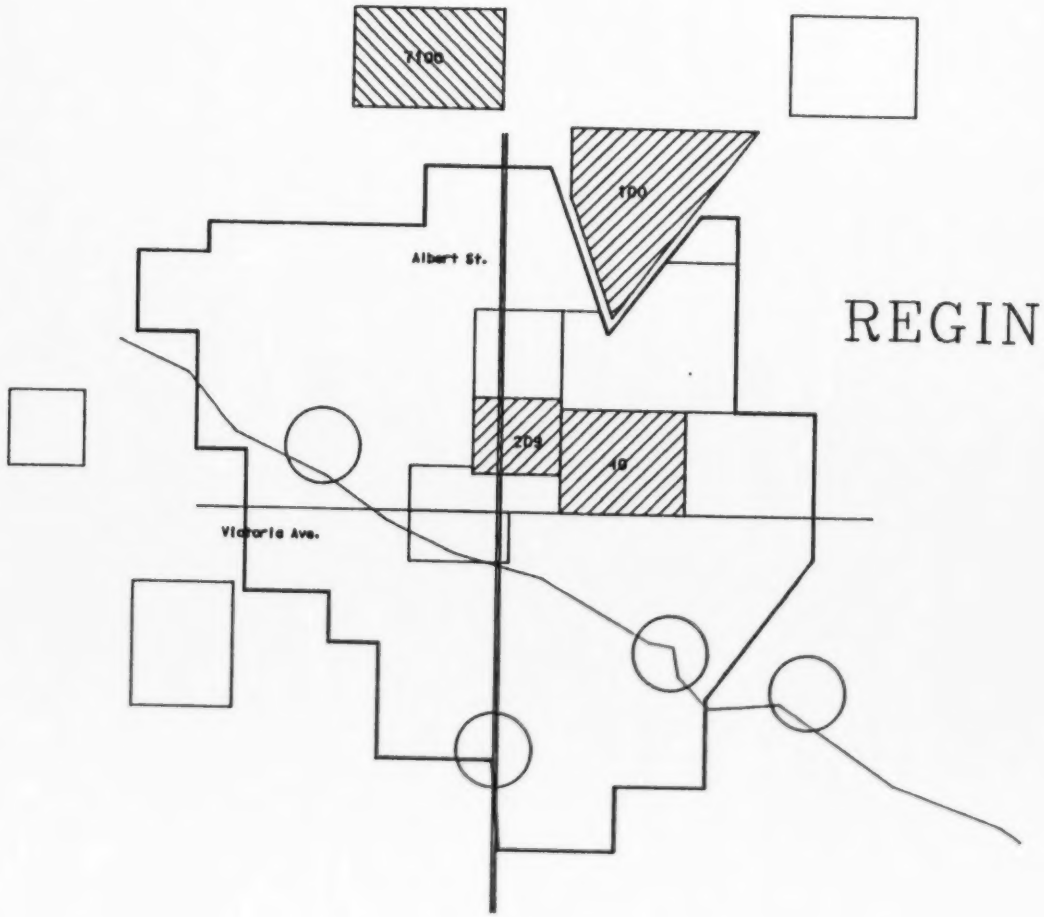


Figure C-5
CLASS 8 - SPILLS
SASKATCHEWAN ENVIRONMENT
REGINA AQUIFER
HAZARDOUS CHEMICAL STUDY
1989

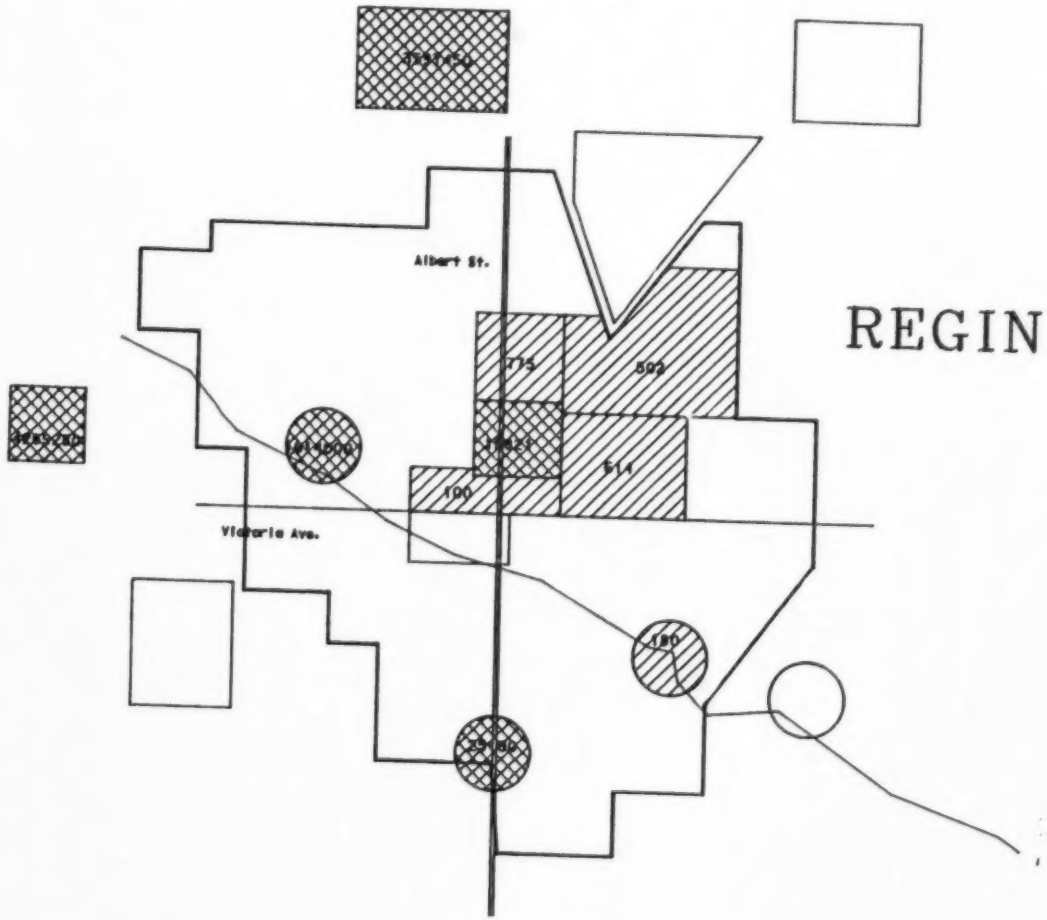


Figure C-6
CLASS 9 - SPILLS
SASKATCHEWAN ENVIRONMENT
REGINA AQUIFER
HAZARDOUS CHEMICAL STUDY
1989

APPENDIX D

SEWAGE AND WASTE DISPOSAL

	PAGE
LAGOONS AND LANDFILLS	D-1
INACTIVE LANDFILLS	D-2

SASKMONT ENGINEERING LTD.

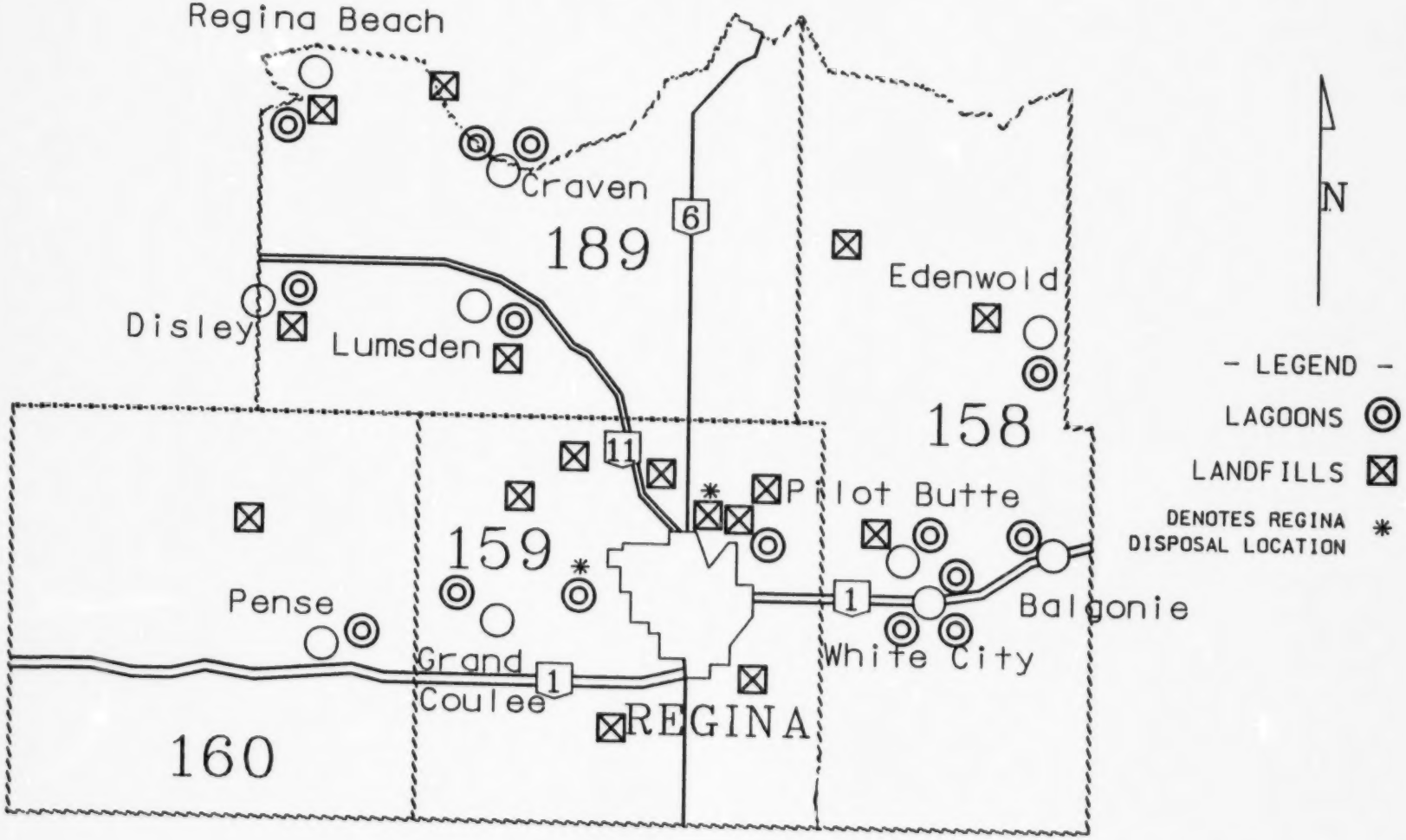
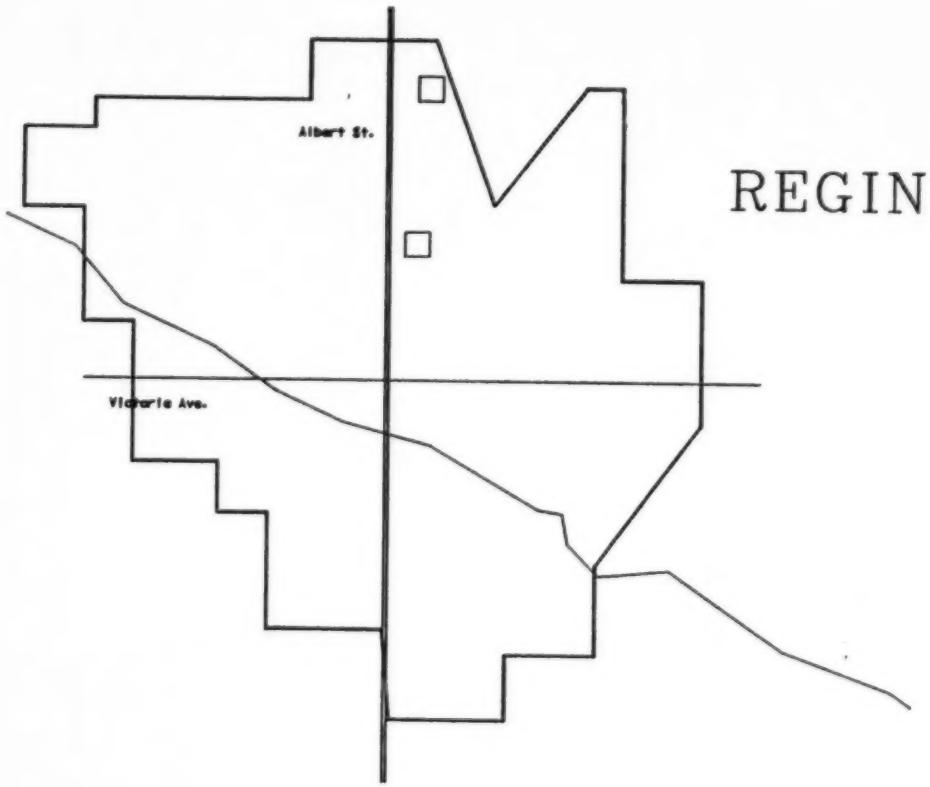


Figure D-1
LAGOONS AND LANDFILLS
SASKATCHEWAN ENVIRONMENT
REGINA AQUIFER
HAZARDOUS CHEMICAL STUDY
1989



REGINA

N

INACTIVE LANDFILLS

Figure D-2

INACTIVE LANDFILLS

SASKATCHEWAN ENVIRONMENT

REGINA AQUIFER
HAZARDOUS CHEMICAL STUDY
1989